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Civilian Radioactive Waste Management System
Management & Operating Contractor

Repository Surface Design Engineering Files Report

BCB000000-01717-5705-00009, Rev 03

June 10, 1999

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Revision/History of Change Page		
Revision No.	Date	Description
00	12-30-97	Initial Issue
01	3-2-98	Revision to include clarifications to the text and some additional numerical data. The numerical data provided in the previous revision did not change.
02	3-23-99	Revision to include Viability Assessment design descriptions and revisions to numerical data. Extensive updates to numerical data in Tables 3-1, 4-2, 5-1, 6-1, 6-2, 6-3, 6-4, and 6-6. Inclusion of new Cask Maintenance Facility attachment.
03	6-9-99	Revised to incorporate miscellaneous comments as received from DOE in transmittal May 18, 1999. The numerical data provided in the previous revision did not change.

CONTENTS

CONTENTS, Continued

CONTENTS, Continued

CONTENTS, Continued

APPENDIX:

ATTACHMENTS:

FIGURES

TABLES

1. INTRODUCTION

1.1 OBJECTIVE

The objective of the *Repository Surface Design Engineering Files Report* is to provide the surface design data needed by the Environmental Impact Statement (EIS) contractor to prepare the EIS and evaluate options and alternatives.

1.2 SCOPE

The report provides the engineering data needed by the EIS contractor to prepare the EIS and evaluate options and alternatives. The engineering data are provided for the repository surface facilities located at the North Portal, and the site-wide utility and transportation systems. This report does not provide data for the surface facilities supporting subsurface operations at the South Portal or the shaft access areas, off-site transportation systems, off-site utility systems, or waste package fabrication. EIS data for these design areas are provided in other engineering files. The report also does not include engineering data associated with the studies relating to features and alternatives being considered for the License Application Design (LAD).

Updates to the report will be coordinated with the program plans for completion of important surface design analyses when possible, and as required by the EIS contractor. These updates include the Viability Assessment (DOE 1998b, Volume 2, Section 4.1, pp. 4-1 to 4-38) design descriptions, drawings, and requested design data. Certain interim updates may be made to the report based on requests for information in one or a few areas of the report. These interim updates may not include a global update of the report.

The EIS data provided in this report include the following:

A. Description of program phases (i.e., Site Characterization, Construction, Emplacement Operations, Caretaker Operations, Closure, and Postclosure)

B. Description of the surface design evolution.

C. Description of the major design requirements and assumptions that drive the surface facilities reference design (i.e., Viability Assessment (VA) design) (DOE 1998b, Volume 2, Section 4.1, pp. 4-1 to 4-38)

D. Description of the reference design concept as provided in Section 4 of this document.

E. Description of changes from the reference design for alternative design cases. These cases were selected to provide EIS data that address the alternatives and options identified in the Notice of Intent (NOI) (DOE 1995, pp. 12-16). Additional design cases address alternative inventory modules that reflect disposal of additional waste forms and waste quantities.

F. Description of changes from the reference design and the alternative design cases that address additional inventory modules. These cases reflect disposal of additional waste forms and waste quantities.

G. Tabular summary level engineering values (i.e., staffing, wastes, emissions, resources and land use) for the reference design and the alternative design cases that address construction, emplacement operations, caretaker operations, and closure.

H. Description of a design concept for the complete retrieval and storage of waste packages and summary level engineering quantities for the construction and operation of this concept.

I. Description of a design concept for a dry waste staging facility with a waste storage capacity of 10,000 metric tons of heavy metal (MTHM).

J. Description of a design concept for an on-site Cask Maintenance Facility to provide for shipping cask repair and re-certification (Attachment III).

1.3 QUALITY ASSURANCE

The report provides bounding design information that will be used to begin preparation of EIS documentation. The activities associated with the production of this document are not subject to the *Quality Assurance Requirements and Description* (QARD) (DOE 1997c) requirements, as all EIS work is exempt from the QARD requirements. This determination is documented in the activity evaluation, *DEIS Support* (CRWMS M&O 1998a). *The Repository Surface Design Engineering Files Report* is prepared in accordance with procedure PRO-TS-003, *Development of Technical Documents not Subject to QARD Requirements.*

The data provided in this report have been reviewed to ensure that the information provides a reasonable basis for understanding the impacts of design, construction, operation, closure, and postclosure on the environment. The data should not be used as design input to an analysis, technical document, drawing or specification.

1.4 PROGRAM PHASES

As depicted on Figure 1-1, six phases comprise the evolution of the potential repository: Site Characterization, Construction, Emplacement Operations, Caretaker Operations, Closure, and Postclosure. Each phase is described in the following sections:

1.4.1 Site Characterization Phase

The Site Characterization Phase includes those activities associated with gathering and evaluating data to determine the suitability of the site for a geologic repository; predicting the performance of the repository; preparing the repository design, and assessing the system performance. The Exploratory Studies Facility that has been constructed includes several surface facilities. Some of these facilities will be enhanced; others will be removed or relocated, as necessary, during the Construction Phase.

1.4.2 Construction Phase

The Construction Phase includes constructing and equipping surface facilities, refurbishing Exploratory Studies Facility openings, continued excavation and equipping of subsurface facilities, gathering data to confirm predictions of the repository performance, fabrication of the disposal containers (DCs), and demonstration of some of the repository operations. Current plans are for construction of the surface facilities to begin in March 2005, with the facilities to be in place and operable by the year 2010. Subsurface construction, or development, will continue in parallel with the Emplacement Operations Phase, ending in 2031.

1.4.3 Emplacement Operations Phase

The Emplacement Operations Phase will begin in 2009, and will include preoperational startup and shakedown of the integrated waste handling facilities and systems. Many of the preoperational tests will be performed using simulated waste forms and may include the use of the mockup facility and computer simulations. Operation of the surface facilities will begin in January 2010 and will continue through 2033. Startup of the waste handling system will commence with cask shipments of about one per week during the first year and will gradually build up to about 600 casks being handled per year.

A. Receiving. The potential repository will receive transportation casks loaded with waste. The casks will be moved to the Carrier Preparation Building (CPB), prepared for unloading, and then moved to the Waste Handling Building (WHB).

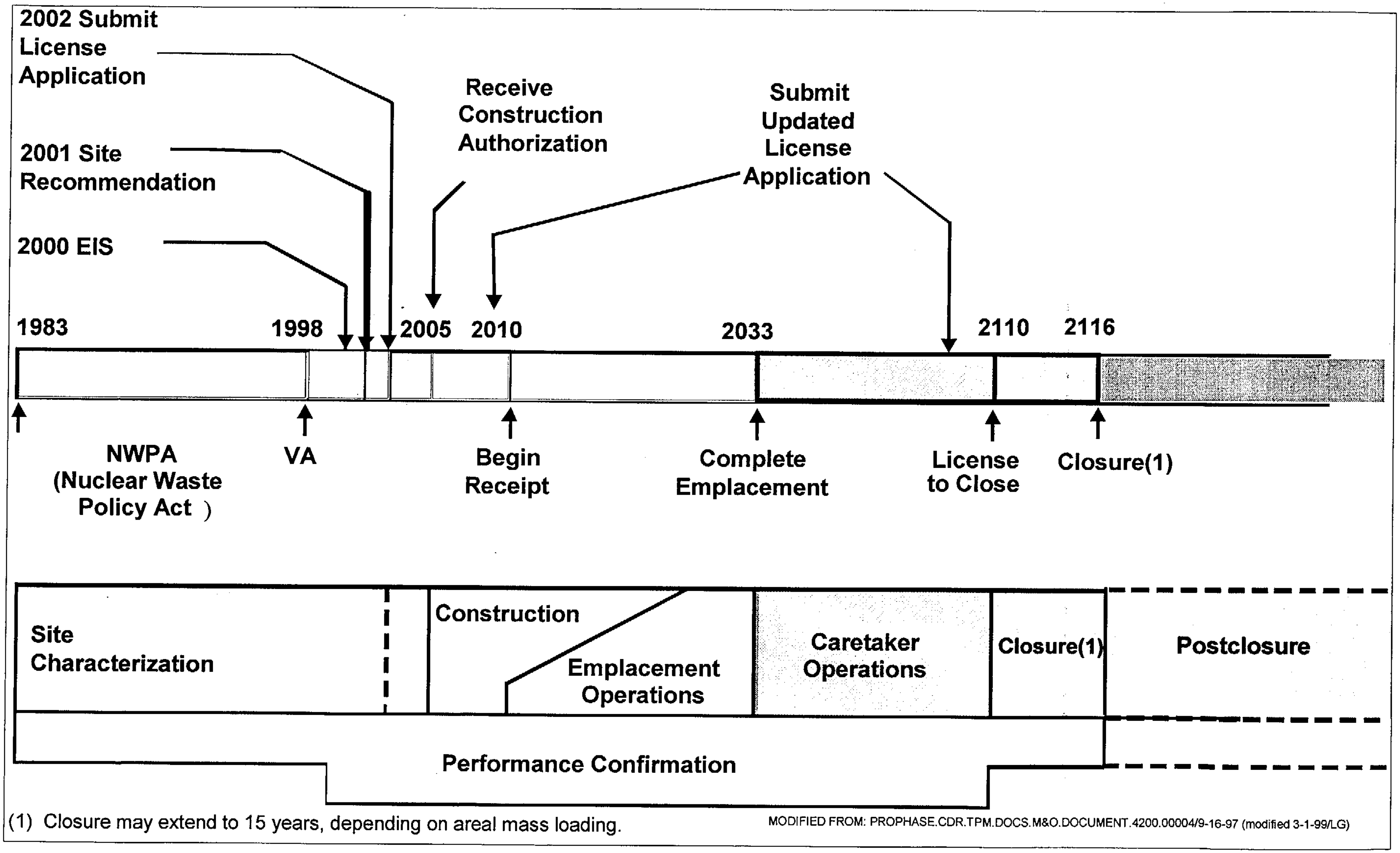

Figure 1-1. MGR Phases and Regulatory Milestones

B. Packaging. In the WHB, the casks will be unloaded, opened, and the waste removed. The waste will be loaded into a DC, which is then welded and inspected. After welding and inspection, the DC is referred to as a waste package. The waste package will be loaded into a subsurface transporter in preparation for underground emplacement. The waste package can also be staged in the WHB to await loading on a transporter.

C. Emplacement. After the transporter is loaded, it will move the waste package from the WHB to the subsurface emplacement drift. The waste package will then be unloaded into the assigned emplacement drift and positioned in the drift using a remotely controlled gantry.

1.4.4 Caretaker Operations Phase

The Caretaker Operations Phase will begin when all waste packages have been emplaced. This phase will include decontaminating surface facilities, mothballing non-essential surface facilities (e.g., facilities not required for possible waste retrieval), continuation of performance confirmation activities, and maintenance of the subsurface facility. The capability to retrieve the waste packages also will be maintained. The Caretaker Operations Phase ends when closure begins, which, for the purposes of this report, is expected to be 100 years after the beginning of emplacement operations.

1.4.5 Closure Phase

The Closure Phase will begin after the license to close the repository has been received from the U.S. Nuclear Regulatory Commission (NRC). This phase includes closing and sealing the subsurface facilities; final decontamination (e.g., scalping the concrete and disposal of contaminated waste), and removing the surface facilities; constructing monuments; creating institutional barriers; and returning the site to its natural condition, as required by the NRC. The expected duration of this phase is estimated to be 6 to 15 years, depending on the areal mass loading.

1.4.6 Postclosure Phase

During the Postclosure Phase, the engineered and natural barriers will contain and isolate the radioactive waste for thousands of years. This phase will include the capability to provide postclosure monitoring, if it is necessary.

1.5 SURFACE DESIGN PHASES

The repository design has evolved into the current reference design. To date, no conditions have been found that disqualify Yucca Mountain as a potential repository site. Should Yucca Mountain be accepted as a viable site, design activities will move into the License Application (LA) phase. With submittal of the license application, and its approval, final (detail) design for repository construction and equipment procurement will begin.

1.5.1 Site Characterization Plan - Conceptual Design

Decisions and data derived from preconceptual studies were incorporated in the Site Characterization Plan Conceptual Design (SCP-CD), which was documented in the SCP-CD Report in 1987 (SNL 1987, Vol. 2, Sect. 4.2, pp. 4-9 through 4-76). The design was used to plan the site characterization activities and tests and became the reference design for a total system life cycle cost (TSLCC) estimate. These studies changed the mining methods, emplacement mode, and repository horizon and established the first conceptual design for the surface facilities.

The SCP-CD was based on emplacement of small waste packages in vertical boreholes in a repository that was accessed by vertical shafts. The design of the surface facilities included two waste handling buildings (to accommodate a phased start-up), a performance confirmation building, a waste treatment building, and a number of support facilities.

1.5.2 Advanced Conceptual Design

The design presented in the Advanced Conceptual Design Report (ACD) (CRWMS M&O 1996a) changed elements of the SCP-CDR to accommodate the use of multi-purpose canisters (MPCs). MPCs are large canisters containing 12 to 44 commercial spent nuclear fuel (CSNF) assemblies that are loaded at the reactor sites, shipped to the repository, and placed directly into a DC for disposal. (DCs are referred to as waste packages (WPs) once they are ready for emplacement.) Use of MPCs significantly affected the waste handling operations and changed the emplacement mode to a horizontal configuration. The ACD design phase started in FY93 and ended in March of 1996.

During the ACD design phase, the engineers also identified solutions to design-related licensing issues, incorporated site characterization repository horizon data, added a cask maintenance facility, incorporated the elimination of a phased start-up of waste handling operations, consolidated the performance confirmation operations into the WHB, revised the site-generated Waste Treatment Building (WTB) design, and incorporated the ESF excavation of the North Ramp, TSw2 Main, and the South Ramp. Subsequent to the ACD effort, the Cask Maintenance Facility (CMF) was removed from the repository site and the mostly MPC waste form schedule

Facility (CMF) was removed from the repository site and the mostly MPC waste form schedule was changed to a mostly uncanistered waste schedule, resulting in the current waste handling system designs. That surface design concept is defined in the next section.

1.5.3 Viability Assessment Design

The design presented in the *Viability Assessment of a Repository at Yucca Mountain* (the VA design) (DOE 1998b, Volume 2, Section 4.1, pp. 4-1 to 4-38) provides data to develop the four products identified in the FY97 *Energy and Water Development Appropriations Act* (USC 1996), including: a design concept for the critical elements, a total system performance assessment, a plan and cost estimate for completing the license application, and a cost estimate to construct and operate the repository. The VA design phase, started in FY96, was completed in mid-FY98.

In the current reference design, the surface facilities handle predominantly uncanistered fuel. Commercial bare fuel will arrive in dual-purpose canisters (DPCs) or in licensed transportation casks. At the repository, the casks are opened, the DPCs are removed from the cask and opened, the bare fuel is loaded into a disposal container, the casks are prepared for re-use, and the DPC pieces are disposed of. The remainder of the waste (defense high-level waste and U.S. Department of Energy (DOE) spent nuclear fuel (SNF)) will arrive in disposable canisters, which are unloaded from the shipping casks and loaded directly into disposal containers.

The cask configurations with bare fuel, disposable, and non-disposable containers are described in Table 2-1. The surface facilities will be designed to handle shipping casks containing bare fuel, dual-purpose (non-disposable) canisters, and disposable canisters at the rates described in Table 2-2.

The waste will be unloaded in the WHB, and the bare fuel or disposable containers will be individually placed into the waste packages, which will then be welded and sealed. This process results in many more handling steps than were required in the MPC-based ACD (CRWMS M&O 1996a) . Fuel handling water pools were incorporated into the WHB to facilitate the assembly handling. In the current reference design, the CMF has been eliminated due to a decision to do cask maintenance off-site. In the event that the CMF is relocated at the repository, the CMF as described in the ACD (CRWMS M&O 1996a, Section 7.2.3, pp. 7-132 through 7-177) is the basis for the CMF engineering file data provided as Attachment III to this report.

1.5.4 License Application Design

Engineering design produces an evolving product that may be captured as a reference design and presented in a document. The current reference design, the VA design, is the basis of this document, and was presented in the Viability Assessment document completed in 1998 (DOE 1998b, Volume 2, Section 4.1, pp. 4-1 to 4-38). The evolution from VA design will result from examining alternatives to the VA design, incorporating approved alternatives, and expanding and confirming the objectives in the VA design, with an emphasis on systems that impact radiological safety. The next Surface reference design, the LA design, will be captured in late fiscal year (FY) 2000. The LA design will be used to prepare the license application to be submitted to the NRC in 2002.

1.6 PROGRAM FACTORS THAT INFLUENCED SURFACE DESIGN

A number of factors, many external, have influenced the design approaches and operational concepts of the surface facilities. Those that have had the greatest design impact are discussed in the following sections:

1.6.1 Waste Package Size and Weight

The VA design concept for waste emplacement uses a large, robust waste package that will be emplaced horizontally in emplacement drifts. The waste package will hold either 21 pressurized water reactor (PWR) assemblies or 44 boiling water reactor (BWR) assemblies. The overall weight of the waste package will be less than 76 tons. The largest canistered waste form to be handled is naval SNF in sealed, disposable canisters that weigh about 49 tons and have a total weight in the sealed waste package of about 91 tons (DOE 1998b, Volume 2, p. 4-5). Earlier concepts used much smaller and lighter waste packages that could be emplaced in either vertical or horizontal bore holes and which contained typically four or five assemblies. This allowed the use of conventional handling equipment that has been developed and used in hot cell applications. The large waste packages will require hot cell equipment that is capable of handling heavy loads and sizes, and of minimizing adverse effects from a drop, including radiation release and damage to safety systems. The design and specification of this equipment will require development and demonstration to confirm its operability, reliability, availability, maintainability, and safety.

The large waste packages reduce the number of shipments that are needed for transporting them to the emplacement location and also reduce the number of waste packages that will be manufactured over the number that would be required for the smaller sized waste packages. In the surface facilities, the individual assemblies must be placed into the waste packages one at a time. The number of times that fuel assemblies are handled is about the same in either case. A major step in the waste package preparation in the WHB is the welding and sealing of the lids onto the waste package. The larger and thicker waste packages require longer welding times, but, overall, less raw material is used.

The handling of the large and very heavy waste packages in the dry hot cells of the surface facilities involves large, heavy-duty cranes and handling equipment. This activity results in a large facility when all the handling steps are incorporated, with substantially larger support operations, such as heating, ventilating, and air conditioning (HVAC); water treatment; remote maintenance; and other services necessary to insure safety and operability.

1.6.2 Rod Consolidation

Rod consolidation was considered in earlier designs as a way to reduce the size of the waste packages. It involved the disassembly of the fuel assemblies in hot cells and compacting them into the waste packages. Many studies were done to evaluate the merits and demerits of this concept, all of which recommended that rod consolidation was not a viable option. A *Statement of Position on Rod Consolidation* (CRWMS M&O 1993) was issued in 1993 which accepted the results of the many rod consolidation studies and which took the position that rod consolidation would not be pursued. This decision had a major impact upon the operations of the surface facilities in that it removed the many steps that would be necessary to perform the function and reduced the amount of site-generated waste that would be produced in the handling activities.

1.6.3 Canistered and Uncanistered Waste

The form that the waste is in when it arrives at the surface facilities has a profound impact upon the way that the surface facilities are designed and operated. Waste materials that arrive in disposable canisters (canisters that can be placed directly into DCs for disposal), and that have little or no surface contamination, involve much less handling than waste that must be individually handled and which has very high amounts of surface contamination. The amount of surface contamination that must be dealt with during handling has a direct effect upon the amount of low-level radioactive waste that will be generated during operation, decontamination activities, and decommissioning. Waste generated at donor sites will be handled and disposed at those sites.

1.7 RADIATION EXPOSURE

The exposure to radiation and hazardous material involves some level of risk. The design of the structures, systems, and components of the surface facilities will be done to maintain these exposures to reasonably low levels on the basis of the state of technology and the economics involved. The philosophy and principles of "as low as reasonably achievable" (ALARA) will be used during the design and operation of the surface facilities and will be instituted under the guidance of the *MGDS Design ALARA Program* (CRWMS M&O 1995b) (See Section 2.5, Section J of this document). The ALARA Program describes the key features of where and how ALARA will be implemented and establishes the guidelines under which necessary studies will be conducted to assure that the design and operation of the surface facilities will incorporate the necessary components to assure the radiological safety of the Monitored Geologic Repository (MGR) in a reasonable, efficient, and economic fashion.

2. DESIGN REQUIREMENTS AND ASSUMPTIONS

The following primary requirements and assumptions drive the current reference design of the repository surface facilities, as indicated. Assumptions from the *Controlled Design Assumptions* Document (CDA) (CRWMS M&O 1998b) are identified by assumption number (either Key assumption or Design Concept Surface (DCS) assumption) in parentheses following the assumption.

2.1 WASTE ACCEPTANCE

A. The maximum expected sizes and weights of the casks, canisters, assemblies, and DCs handled at the repository are as shown in Table 2-1.

B. High-level waste (HLW) and DOE SNF will be received in disposable canisters (DISPCs). (CDA Key 001, 002, and 003, pp. 3-1 through 3-14). A small amount of DOE SNF received will be uncanistered.

C. The repository will not accept waste forms that cannot be lifted to and handled in a vertical orientation (CDA Key 085, p. 3-80).

D. The site will have the flexibility to handle approximately 50 MTHM of weapons-grade and immobilized plutonium (CDA Key 088, pp. 3-86 and 3-87).

E. The site will have the flexibility to handle approximately 300 canisters of naval fuel with the characteristics defined in CDA Key 086, p. 3-81 and 3-82.

Table 2-1. Physical Characteristics of Casks, Canisters, Assemblies, and Disposal Containers

Waste Form	Maximum Length (inches) (without impact limiters)	Maximum Cross Section (inches)	Maximum Loaded Weight (tons)
Rail Transportation Cask	230	103	120
Truck Transportation Cask	218	68	40
CSNF Canister	193	61	38
HLW Canister	118	24	3
DOE SNF Canister	165	26	10
CSNF PWR Assembly	201.1	8.54	1,920 pounds
CSNF BWR Assembly	78.5	6.81	668 pounds
CSNF Disposal Container	231	77	76
Hanford HLW Disposal Container	211	79	64
DOE SNF / HLW Disposal Container	149	78	42
Naval Fuel Canister (longest)	212	66.5	49

Source: *Supplemental Data for Repository Surface Design Engineering Files Report* (CRWMS M&O 1999b).

2.2 WASTE RECEIPT AND EMPLACEMENT SCHEDULE

A. The repository will be capable of receiving and emplacing 70,000 MTHM of waste over 24 years starting in 2010. This is consistent with a peak annual receipt rate of 3,000 MTHM, co-disposal of some DOE SNF with HLW, and the data provided in Table 2-2. (CDA Keys 001, 002, and 003, pp. 3-1 through 3-14.)

B. The repository will require the capability to annually handle about 300 DISPCs (e.g., MPCs) containing CSNF (CDA Key 001, p. 3-1 through 3-6).

C. Shipments are received and brought into the site Radiologically Controlled Area (RCA) 24 hours per day.

D. Casks will be received by legal-weight truck (LWT) or rail. A rail cask shipment will arrive at the repository as a unit train. A unit train consists of one to two locomotives, three to five rail cars carrying casks, and buffer rail cars between rail cars carrying casks. Rail cars carry one cask each.

Table 2-2. Reference Design Waste Receipt and Emplacement Schedule

Year	Cask/Carrier Handling			Assembly Transfer Lines				Canister Transfer Lines			Total
	Truck	Rail	Total	Casks	DPCs	Assys.	DCs	Casks	DISPCs	DCs	DCs
2010	32	26	58	57	25	1,037	37	1	1	1	38
2011	32	78	110	109	6	2,317	75	1	1	1	76
2012	49	167	216	213	2	4,233	149	3	3	3	152
2013	74	277	351	345	24	6,497	245	6	6	6	251
2014	95	453	548	540	10	10,403	365	8	8	8	373
2015	86	570	656	519	14	10,069	363	137	626	140	503
2016	117	579	696	551	22	10,405	368	145	659	156	524
2017	100	571	671	533	43	9,977	367	138	609	125	492
2018	114	578	692	541	48	10,399	367	151	678	157	524
2019	115	570	685	532	96	9,987	366	153	644	141	507
2020	109	544	653	499	123	10,197	368	154	645	142	510
2021	89	536	625	471	161	10,182	363	154	645	142	505
2022	110	526	636	496	177	10,095	376	140	585	123	499
2023	108	515	623	483	179	10,043	362	140	585	123	485
2024	93	509	602	457	199	10,261	367	145	605	128	495
2025	124	545	669	519	250	11,007	377	150	625	133	510
2026	0	578	578	429	411	12,250	381	149	613	127	508
2027	0	565	565	418	381	11,425	369	147	605	123	492
2028	0	523	523	376	347	10,867	356	147	605	123	479
2029	0	545	545	364	347	10,457	350	181	765	143	493
2030	0	539	539	352	319	10,646	363	187	801	150	513
2031	0	526	526	345	302	9,962	350	181	781	149	499
2032	0	427	427	284	6	10,040	360	143	548	113	473
2033	0	276	276	171	1	6,388	223	105	379	89	312
Total	1,447	11,023	12,470	9,604	3,493	219,144	7,667	2,866	12,022	2,546	10,213
Max	124	579	696	551	411	12,250	381	187	801	157	524

Source: CDA Key 001, Table 3-1, p. 3-4.

E. Cask turnaround times will support the projected arrival schedule of casks as set forth in Tables 3-1 through 3-4 in CDA Key 001, pp. 3-1 through 3-6. During surges in commercial waste shipments, cask turnaround times will be met if the monthly rate for CSNF does not exceed 300 MTHM (i.e., 20 percent higher than average) for four consecutive months.

F. The annual inventory of spent fuel and high-level waste that will arrive at the repository by transportation mode, packaging, and waste type are as specified in CDA Key 001, 002, and 003, pp. 3-1 through 3-14.

2.3 SITE LAYOUT AND OPERATIONS

A. A restricted area boundary will be established around the nuclear surface facilities with a radius of 3.1 miles (5 kilometers) (CDA Key 071, p. 3-63).

B. The CPB, WHB, and WTB will be constructed above the probable maximum flood (PMF) elevation because flooding of these facilities could lead to a release of radioactive contamination to the accessible environment. All other facilities will be designed to withstand the 100-year flood, based on common industrial design practice. This assumption is consistent with the current reference design (CRWMS M&O 1998c, Section 4.1.5, p. 9), and does not preclude other means of flood control if later determined necessary.

C. The existing North Portal site pad will not require re-engineered fill (i.e., removal of existing soils and reconstruction). This concept is consistent with the use of a mat foundation for the WHB. (This will require confirmation with a site-specific geotechnical investigation and WHB foundation recommendations by qualified geotechnical engineers). This assumption is consistent with the VA design, and does not preclude the use of engineered fill if later determined necessary.

D. The site will be developed to support site characterization operations prior to initiation of repository construction. Existing site facilities and structures are as described in Section 4.2.2 of this report.

E. At closure, all non-permanent surface structures will be removed and the site will be graded to blend with the natural terrain.

2.4 WASTE HANDLING

A. Disposable canisters containing SNF will not be opened at the repository to make burnup or thermal measurements. The WHB will have the capability to make these measurements for assemblies that do not arrive in sealed canisters (CDA Key 057, p. 3-42.).

B. Transportation cask maintenance and decontamination will not be performed at the repository site except for the incidental maintenance and decontamination needed to ship the casks off-site to a Regional Service Contractor (RSC)-operated cask maintenance facility (i.e., a cask maintenance facility is not provided at the repository) (CDA Key 080, p. 3-74). An engineering file is provided to this report (Attachment III) for a CMF, should the facility be located on-site.

C. The waste handling concept will use waste unloading and staging pools to open casks and DPCs and unload and stage SNF assemblies. Other operations will be performed in dry hot cells (CDA DCS 020, pp. 6-7 and 6-8).

D. Facilities will not be provided for fuel rod consolidation (CDA Key 008, p. 3-21).

E. Special tooling will be required to handle and unload a variety of waste forms, including: 15 configurations of shipping casks, 12 configurations of spent fuel assemblies, and 3 configurations of DISPCs (CDA DCS 021, p. 6-9). There are multiple disposal container (DC) configurations (different outer diameter and length) with 13 variations of the multiple DC configurations. There are multiple 12 and 21 PWR assembly DC configurations, 24 and 44 BWR assembly DC configurations, some with absorber plates or absorber rods, and some without (CRWMS M&O 1998g, p. 3). There are also multiple DCs for canistered waste, defense high-level (vitrified) waste, short and long naval fuel, and DOE fuel.

F. Facility design and construction required for waste retrieval from the underground emplacement will be performed when, and if, retrieval of DCs is required or directed. Land area will be reserved to store the retrieved waste. For the purposes of this report, a retrieval period of up to 100 years after emplacement is assumed (CDA Key 016, p. 3-25, and 065, p. 3-57).

G. The repository will include the capability to conduct off-normal operations on canistered waste, including the opening of a DC and repackaging the waste for emplacement (CDA Key 053, p. 3-39).

H. Waste Handling Equipment will accommodate a range of weights and dimensions for the commercial spent fuel to be handled, per Table 2-1.

2.5 FACILITY DESIGN

A. Facility design for earthquakes, including both safety and non-safety-related structures, systems, and components (SSCs), shall follow *Preclosure Seismic Design Methodology for Geological Repository at Yucca Mountain* (DOE 1997d).

B. Acceptance criteria for safety related SSCs will be as given in NRC NUREG-800 Standard Review Plan (SRP) 3.71, *Seismic Design Parameters*, SRP 3.7.2, *Seismic System Analysis*, and SRP 3.10, *Seismic and Dynamic Qualification of Mechanical and Electrical Equipment.*

C. Facility requirements design to withstand tornados and tornado wind missiles are to be determined for safety related SSCs.

D. Safety class systems will provide confinement for WHB areas handling uncanistered waste, canistered waste, or waste in unsealed DCs. These systems will operate continuously following a design basis event.

E. Airlocks identified within the WHB and WTB will be provided to maintain confinement pressure zoning.

F. At the end of the Emplacement Operations Phase, the surface facilities will be extensively decontaminated. Facility systems will be shut down and preserved, and the facility will be closed and secured.

G. The facilities will be designed to accommodate decommissioning, dismantlement, and decontamination of the potentially contaminated equipment and building structure.

H. Support facilities (e.g., administration, utility building, central warehouse, maintenance shops, fire/medical, service stations, security stations, visitor center, and training) are as described in the *Site Characterization Project Conceptual Design* (SCP-CD) and are suitable for supporting repository operations without further definition in the current reference design (CDA DCS 019, p. 6-6).

I. Facility designs to comply with currently undefined material control and accountability (MC&A) and International Atomic Energy Agency (IAEA) requirements are not addressed at this time.

J. Occupational exposures to radioactive materials will be minimized through engineering controls to be as low as reasonably achievable (ALARA) and to provide reasonable assurance that the 500 millirem per year administrative limit will not be exceeded (CDA Key 089, 090, 091, pp. 3-88, 3-89, and 3-91).

2.6 LAG STORAGE

A. Commercial waste will be emplaced in approximately the same order it is received. Less than 10 percent of the monthly throughput of SNF assemblies will be staged in the WHB before or after unloading from the casks. This staging is required to accommodate variations in operational throughput, and in waste form and disposal container compatibility (CDA Key 078, pp. 3-71 and 3-72).

B. Lag storage will not be provided to accommodate the early receipt of waste materials (e.g., begin receipt in 2007 and begin emplacement in 2010) (CDA RDRD 3.7.4.1.A.2, p. 5-24).

C. Lag storage for SNF and HLW is provided within the WHB to accommodate minor interruptions in waste handling operations. This includes a two-week storage capacity in the event the subsurface repository is not available, and buffer or holding areas located within the operations areas. An aggressive maintenance strategy will be used to minimize failures and the time required to return to normal operations.

D. In-process staging areas will be provided within the WHB with sufficient capacity to complete operations to a reasonably safe shut-down condition in the event of an unplanned stoppage, accommodate receipt surges, and facilitate the independent management of major waste handling operations (CDA RDRD 3.7.4.1.A.3, p. 5-25).

E. DC designs for CSNF will be provided with and without absorber plates.

F. Assembly lag storage will be provided to accumulate compatible types of commercial assemblies.

2.7 SECONDARY WASTE MANAGEMENT

A. Low-level waste (LLW) will be treated and packaged at the repository. Hazardous wastes will be shipped off-site for treatment and disposal (CDA Key 024, p. 3-31, RDRD 3.7.3.9.E, p. 5-23). The Nevada Test Site (NTS) will be used for off-site low-level waste disposal (CDA Key 82, p. 3-76).

B. Underground emplacement operations will not generate secondary mixed or low-level radioactive wastes (CDA DCS 011, p. 6-3).

C. The Waste Treatment Building will not process secondary transuranic waste or HLW. If such materials are generated, they will be packaged as the point of generation and disposed in the underground emplacement area via the Waste Handling Building (CDA DCS 012, p. 6-4).

The waste handling process is not expected to produce transuranic waste or HLW.

D. Radioactive wastes generated by performance confirmation will be minimal and will not impact the WTB design (CDA DCS 013, p. 6-5).

E. All solid LLW will be grouted to comply with the acceptance criteria of the disposal site. Note: If the disposal site does not require grouting of the solid LLW (excluding spent resin), then the volume of the post-treatment solid LLW waste will decrease by about 22 percent.

F. All compactible solid LLW will be compacted and supercompacted to maximize volume reduction. Note: If more detailed analysis eliminates the supercompaction, then the volume of the post-treatment solid LLW waste will increase by about 34 percent.

G. Secondary hazardous, low-level, mixed waste, will be transported to government approved off-site facilities. Empty DPCs will be packaged and shipped off-site for disposal/recycle (Modified CDA Key 024, p. 3-31).

2.8 GASEOUS RADIOACTIVE EMISSIONS

Gaseous radioactive emissions are calculated based on the methodology in the *Repository Radiation Shielding Design Guide* (CRWMS M&O 1997z), and the following assumptions are made:

A. PWR burnup for the current reference equipment designs is assumed to be about 40 GWd/MTHM, assuming 3.7 percent enrichment and an average of 26 years.

B. BWR burnup for the current reference equipment designs is assumed to be about 32 GWd/MTHM, assuming 3.0 percent enrichment and an average of 27 years.

C. The failure rate is assumed to be 0.25 percent of assemblies processed in years 2026, 2018, 2021, and 2027, respectively, for cases S0, S1, S2, and S3. These cases are described in Section 3.3, Design Evaluation Cases.

D. Radionuclides other than krypton, radon, and xenon are sufficiently soluble in pool water to escape gaseous emissions.

2.9 UTILITIES

A. Water will be provided to users at the North and South Portals from nearby wells.

B. Facility heating and operations requiring steam or hot water will be provided to North Portal users from a central steam generation system utilizing fuel-oil-fired boilers.

C. Facility cooling will be provided to North Portal users utilizing central cooling towers and water chillers.

D. Sanitary sewage will be treated on-site at an on-site septic tank and leach field.

E. The current design assumes that solid waste and refuse will be collected and disposed of off-site; however, the option to use a repository site landfill is being maintained. No specific design details of the landfill are available.

F. Electrical power will be distributed by the site electrical power system to surface and subsurface users. Studies to determine the ultimate supplier of electrical power will be conducted.

3. ALTERNATIVES, OPTIONS, MODULES, AND CASES

3.1 NOI ALTERNATIVES AND OPTIONS

The EIS Notice of Intent (NOI) (DOE 1995, pp. 12-16) identified alternatives for thermal loading, design options for the waste transportation mode, and design options for the as-received packaging for CSNF. Each of these alternatives and options is described below. The design evaluation cases described in Section 3.3 were selected to provide the design data needed by the EIS contractor to prepare the EIS and evaluate these NOI alternatives and options.

3.1.1 Thermal Loading Alternatives

3.1.1.1 High Thermal Load Alternative

Under the High Thermal Load implementation alternative, spent nuclear fuel and high-level radioactive waste would be disposed of in an underground configuration that would generate the upper range of repository temperatures while meeting performance objectives to isolate the material. The areal mass loading would likely be around 85 MTHM per acre (CRWMS M&O 1998d, Section 3.2.2, p. 3-7). This alternative would represent the highest repository thermal loading based on available information and expected test results.

3.1.1.2 Intermediate Thermal Load Alternative

Under the Intermediate Thermal Load implementation alternative, spent nuclear fuel and high-level radioactive waste would be disposed of in an underground configuration that would generate an intermediate range of repository temperatures (compared to the High and Low Thermal Load alternatives) while meeting performance objectives to isolate the material. It is assumed that the areal mass loading would be approximately 40 MTHM per acre (CRWMS M&O 1998d, Section 3.2.2, p. 3-7).

3.1.1.3 Low Thermal Load Alternative

Under the Low Thermal Load implementation alternative, spent nuclear fuel and high-level radioactive waste would be disposed in an underground configuration that would provide the lowest potential repository thermal loading (based on available information and expected test results) while meeting performance objectives to isolate the material. The areal mass loading would likely be around 25 MTHM per acre (CRWMS M&O 1998d, Section 3.2.2, p. 3-7).

The reference design is based on 85 MTHM/acre, as referenced in Section 3.1.1.1.

3.1.2 Transportation Mode Options

The NOI identified three transportation modes as options for shipping waste to the repository: several rail corridors, heavy haul truck routes, and legal weight truck (LWT). These options pertain to the transportation mode within Nevada. The national transportation mode (i.e., by truck from the generator site to the repository or shipment by rail to Nevada) may be different. For example, large casks may be shipped to Nevada by rail and then transferred to a heavy haul vehicle for shipment to the repository.

For purposes of generating data to be used by the EIS contractor, three options were derived using the Nevada transportation options: Mostly Rail, Mostly Legal Weight Truck, and Mostly Heavy Haul. All waste is received in transportation casks. Casks weighing up to 40 tons can be shipped by LWT. Larger casks must be shipped by rail or heavy haul truck. Each option is further described below:

3.1.2.1 Mostly Rail

All vitrified HLW, all DOE SNF, and most CSNF is received in large casks transported by rail. CSNF from shipper sites that cannot accommodate large casks is shipped in smaller casks by LWT. The Mostly Rail option is attractive because the use of larger casks minimizes the number of shipments for a given quantity of waste, and rail transportation has a significantly lower operations cost than heavy haul truck transportation. The reference design is consistent with this option.

3.1.2.2 (Mostly) Legal Weight Truck

All waste, except for certain fuel of naval origin which requires rail size casks, is received in legal weight truck casks. However, the analyses reported in this engineering file assume that all waste does arrive by truck carrier. No allowance has been made for the impact of the limited number of casks containing this naval fuel that would need either rail service or oversize truck carrier transportation.

This option eliminates the cost of installing rail lines, which are not currently available to Yucca Mountain, or upgrading the roads to accommodate heavy haul trucks. This option has a significant effect on the surface facilities because it increases the number of cask shipments, handling, and receipts by approximately a factor of four (Table 5-1).

3.1.2.3 Mostly Heavy Haul

All HLW, all DOE SNF, and most CSNF is received in large casks transported to Nevada by rail, and then by heavy haul trucks to the repository. CSNF from shipper sites that cannot accommodate large casks is shipped in smaller casks by legal weight truck. This option is attractive because the use of larger casks minimizes the number of shipments for a given quantity of waste, and the construction cost associated with heavy haul trucks (i.e., road upgrades within Nevada and intermodal transfer facilities) is less than that for the construction of a Nevada rail line. The larger casks delivered would more closely approximate the reference case and would not have the high throughput and operating costs associated with the Mostly Legal Weight Truck option.

3.1.3 CSNF Receipt Configuration

The NOI identified two CSNF packaging modes as options to be addressed: transportation casks for CSNF that may contain uncanistered fuel assemblies or a canister loaded with assemblies. When the NOI was prepared, the canister option was expected to use an MPC that would have been licensed for dry storage, transportation, and disposal in the repository. The MPC is an example of what is now referred to as a disposable canister (i.e., the canister can be placed directly into an overpack and emplaced in the repository). Other canister options have been identified since the NOI was prepared. The current CSNF receipt configuration options are described below.

3.1.3.1 Non-disposable Canisters

CSNF is received in large casks by rail or heavy haul trucks containing one non-disposable canister (i.e., the canister cannot be placed directly into a DC and emplaced in the repository). It is expected that these canisters would be DPCs, which would be licensed for storage and transportation only. Use of the DPC introduces additional handling, tasks, and containers to the waste handling process for CSNF. Once the transportation cask is opened in one of the Assembly Transfer System (ATS) pools, the DPC is lifted from the cask and set into a prepositioned DPC Overpack on the bottom of the pool. The overpack serves as a stand to support the DPC while the top of the DPC is cut open to allow removal and transfer of the individual spent fuel assembly (SFA) to the pool staging racks. The DPC overpack enters and leaves the site and WHB in the same manner as a transportation cask and requires the same handling as the cask, doubling the number of transfer operations. The handling and opening of the DPC is time consuming and the transfer time of individual SFA remains the same. The DPC in its overpack is shipped off-site for disposal. This option has the greatest impact on the operation of the surface handling facilities and generates the largest quantity of solid LLW.

3.1.3.2 Disposable Canisters (DISPCs)

CSNF is received in large casks by rail or heavy haul truck containing one DISPC (e.g., an MPC). This option has the least impact on the surface facilities because transferring a sealed canister from a cask to a DC is significantly easier than transferring individual assemblies.

3.1.3.3 Uncanistered Fuel Assemblies (UCF)

CSNF is received in casks containing uncanistered fuel assemblies. All CSNF transported in LWT casks is expected to be uncanistered.

The reference design is based on receiving about one-third of the CSNF in DPCs and two-thirds as uncanistered assemblies. HLW and most DOE SNF are expected to be received in DISPCs. A small amount of DOE SNF will be uncanistered.

3.2 INVENTORY MODULES

Subsequent to the preparation of the NOI, it was decided to develop EIS data for alternative inventories. These inventories are described below, along with the baseline inventory. Key quantity data are provided in Table 3-1. Although the data that appear below vary slightly from the most recent definition of the total inventory figures, the analyses reported in this engineering file were prepared based on the data presented in this document.

A. Baseline. The repository will contain 63,000 MTHM of CSNF; 4,667 MTHM of HLW; and 2,333 MTHM of DOE SNF in about 10,200 disposal containers (DCs).

B. Module 1. The repository will contain the baseline wastes plus an additional 42,000 MTHM of CSNF, 6,133 MTHM of HLW, and 167 MTHM of DOE SNF, resulting in approximately 7,087 additional DCs.

C. Module 2. The repository will contain the Module 1 wastes described above plus an additional 40,000 cubic meters of Greater than Class C (GTCC) and DOE Special Performance Assessment Required (SPAR) wastes, resulting in about 4,000 additional DCs. It also will include an additional 50 MTHM of surplus plutonium glass logs, resulting in about 9 additional DCs.

Table 3-1. Disposal Quantities

Option	Baseline	Module 1	Module 2
Waste Quantity (MTHM)	63,000 CSNF [1] 4,667 HLW (8,300 canisters) [7] 2,333 DOE SNF[4] 70,000 Total	105,000 CSNF [1] 10,800 HLW [3] (19,234 canisters) 2,500 DOE SNF [4] 118,300 Total	105,000 CSNF [2] 10,800 HLW [3] (19,234 canisters) 2,500 DOE SNF [4], 40,000 m^3 GTCC & DOE SPAR [5] 50 Pu Glass
DCs[6]	7,667 CSNF 2,546 HLW/DSNF: 10,213 Total	12,960 CSNF 4,350 HLW/DSNF: 17,310 Total	12,960 CSNF 4,350 HLW/DSNF 4,000 GTCC/SPAR[2] 9 Pu Glass 21,319 Total

Source: CRWMS M&O 1997c, Tables 2-5 and 2-6, p. 11, except as noted

Notes:

1. Includes 10 to 100 MTHM of mixed oxide (MOX) SNF (i.e., plutonium and enriched uranium).
2. Includes 1,500 MTHM of MOX SNF.
3. 10,800 is an approximation based on the average MTHM/canister in the baseline case.
4. Includes processed sodium-bonded materials, targets, slugs, and blankets.
5. Includes processed cesium/strontium (1933 capsules).
6. Approximate quantities based on options that include receipt of uncanistered CSNF or CSNF in DPCs.
7. CDA Key Assumption 002 (Number rounded) (CRWMS M&O 1998b, Table 3-8, p. 3-12).

3.3 DESIGN EVALUATION CASES

Eleven design evaluation cases were selected for developing engineering data for the EIS contractor. The selection objectives were to minimize the number of cases while ensuring that the alternatives and options that have the greatest impact on the surface facilities were represented. For example, cases were not included to address the Mostly Heavy Haul transportation option because the EIS data for these cases are expected to be similar to the cases for Mostly Rail.

Three cases, labeled as S1-B, S2-B, and S3-B, accommodate the baseline repository inventory of 70,000 MTHM, which includes CSNF, vitrified HLW, and DOE SNF. The emplacement phase for these cases and the reference design (S0-B) is scheduled to span 24 years.

The remaining eight cases represent two variations on the reference case and three other baseline cases described above. These variations address the alternative inventory Modules 1 and 2, described in Table 3-1. Module 1 cases are labeled S0-1, S1-1, S2-1, and S3-1, and the Module 2 cases are labeled S0-2, S1-2, S2-2, and S3-2. The emplacement phase for these eight cases is scheduled to span 38 years.

The cases are defined in Table 3-2, along with the transportation modes and waste receipt configurations. Each case is described in Section 5. The design of the constructed facilities for these cases is the same as for the corresponding baseline inventory designs (i.e., S0-B, S1-B, S2-B, and S3-B) because the peak annual receipt rates are similar. A further description of the evaluated case designs is presented in Section 5, Description of Evaluation Case Designs.

In addition to the cases identified in Table 3-2, a waste retrieval case was defined to provide engineering data to the EIS contractor. This case requires the full retrieval of the repository contents (i.e., 70,000 MTHM for the baseline inventory) at the end of the Caretaker Phase. In this concept, the waste remains in sealed waste packages and is placed in dry storage . For purposes of developing engineering data only, the storage area is located near the North Portal operations area in Midway Valley. The case is further described in Attachment I.

Table 3-2. Design Evaluation Cases

Design Name Predominant Transportation Mode CSNF Cask Configuration	Reference Design Rail Uncanistered/ DPC	All LWT LWT Uncanistered	Mostly DISPC Rail DISPC	Mostly DPC Rail DPC
Case Numbers				
Baseline Inventory	S0-B	S1-B	S2-B	S3-B
Module 1 Inventory	S0-1	S1-1	S2-1	S3-1
Module 2 Inventory	S0-2	S1-2	S2-2	S3-2
Transportation Mode	88% Rail 12% LWT	All LWT	83% Rail 17% Truck	82% Rail 18% Truck
Waste Receipt Configuration				
CSNF	15% LWT Casks with UCF, 36% Rail Casks with UCF, 49% Rail Casks with DPCs	LWT Casks with UCF	10%LWT Casks with UCF, 90%Rail Casks with DISPCs	8% LWT Casks with UCF, 92% Rail Casks with DPCs
Vitrified High-Level Waste	Rail Casks with DISPCs	LWT Casks with DISPCs	Rail Casks with DISPCs	
DOE SNF				
GTCC & SPAR (Modules 1 and 2 only)				
Vitrified Plutonium				

4. REFERENCE DESIGN DESCRIPTION

4.1 FUNCTIONS

The MGR architecture, as defined herein, consists of the Site Segment, the Repository Segment, and the Engineered Barrier System (EBS) Segment.

The Site Segment does not perform a disposal function, but provides scientific data during the Site Characterization Phase, utilizing both the Exploratory Studies Facility (ESF) and the surface-based testing facilities. The data are required to design the other two segments, and define the operating environment within which they must function. The Site Segment is temporary, and will not exist when the repository begins operations.

The repository is defined as the Geologic Repository Operations Area, and the portion of the geologic setting that provides isolation of radioactive wastes. Additional facilities include non-waste-handling facilities provided to house support functions such as administration, maintenance, personnel support, visitor's center, security, safety, health physics, medical aid station, offices, and support for underground construction. The EBS Segment is defined as the waste package and the underground facility.

The Repository Segment defines the surface and subsurface systems that perform the activities that are needed to handle and emplace the waste. The Surface Segment is the focus of this report, which presents the technical information on the surface facilities and systems needed for the EIS contractor to prepare the EIS.

Figure 4-1 shows the functional association that the surface facilities have with the Civilian Radioactive Waste Management System (CRWMS) program. The functions are primarily as depicted in the *Mined Geologic Disposal System Requirements Document* (CRWMS M&O 1998e, Section 3.1.3, p. 23), which defines those functions that must be performed at the repository in order to dispose of the waste. Some function descriptions have been modified slightly to be consistent with current design terminology.

4.1.1 Mission

The primary mission of the surface facilities is to receive waste shipments and prepare the waste for emplacement. The figure indicates the functions that must be performed to package the waste.

4.1.2 Interfaces

There are three primary interfaces with the repository surface systems: Waste Acceptance and Transportation, Subsurface Emplacement and Development, and the Engineered Barrier.

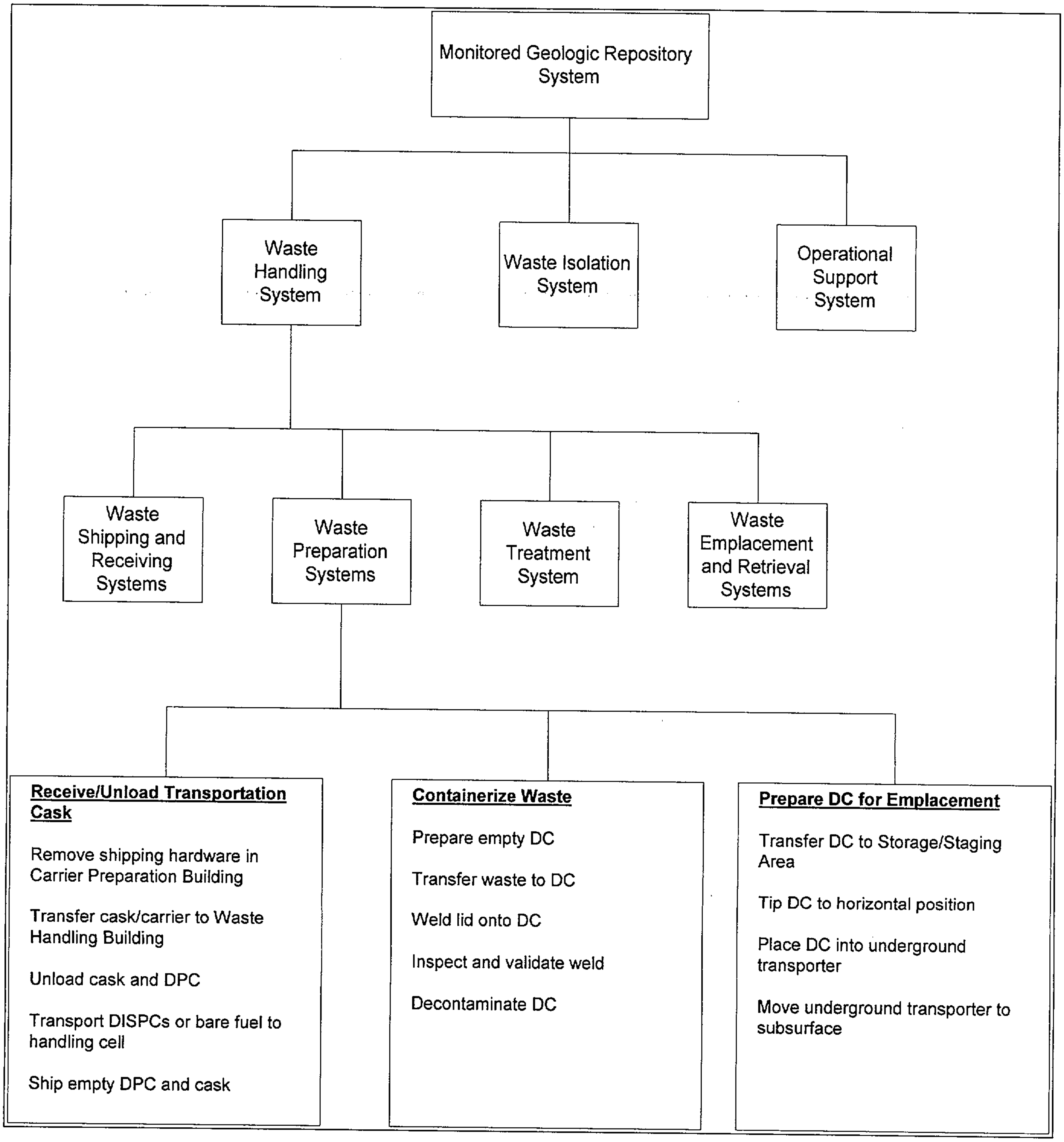

Figure 4-1. Functional Flowdown to Surface Facility Operations

4.2 SITE LOCATION AND DESCRIPTION

This section describes the repository site, including the site conditions prior to repository construction (the Exploratory Studies Facility). The North Portal operational areas and conditions are described, and a concept of site operations, is included. The South Portal, Emplacement Shaft, Development Shaft, and Muck Storage areas are briefly described. These areas are described in more detail in the engineering files document being produced by the Repository Subsurface Department.

4.2.1 Yucca Mountain Location

Yucca Mountain is located in Nye County, Nevada, about 100 miles (by road) northwest of Las Vegas. Refer to Figure 1 in Attachment IV. Access to the area is controlled by the Nevada Test Site.

The Yucca Mountain area is situated on land that lies within the Nevada Test Site, Nellis Air Force Range, and the U.S. Bureau of Land Management (BLM) lands. The Nevada Test Site is reserved for use by the DOE. The western portion of NTS Area 25 has been reserved for the Yucca Mountain Project. The Nellis Air Force Range, withdrawn from the public domain for use by the Air Force, is managed by the BLM. The remaining area is public domain land administered by the BLM.

Yucca Mountain itself is an irregularly shaped volcanic upland 3.75 to 6.25 miles wide and about 25 miles long. It extends from Beatty Wash in the north to the Amargosa Desert in the south, and from Crater Flat in the west to Forty Mile Wash in the east. The repository site is located beneath a ridge known as Yucca Crest. The highest point on Yucca Mountain is at about 6,300 feet, which is about 2,100 feet above the adjacent lowlands.

4.2.2 Pre-Repository Site Conditions

The North Portal site is currently configured for ESF operations, as shown in Figure 2 of Attachment IV, ESF Pre-Repository North Portal Site Plan. The ESF surface facilities were designed, constructed, and operated as non-permanent and non-nuclear facilities with a 25-year maintainable life. Existing ESF surface facilities are shown on Table 4-1. The majority of the surface facilities and equipment are dedicated to site characterization operations, including construction office facilities and utility systems for power, water, compressed air, site waste, and communications.

The current site electrical power system receives power from the NTS electrical power system, and distributes and controls utility and backup power to ESF site users, including the subsurface.

Table 4-1. Existing ESF Surface Facilities - North Portal

Site Map Ref.	Facility Name	Functional Areas	Type of Construction	Principal Dimensions (ft)	Floor Space (ft^2)
5010	Switchgear Building with Transformer	Electrical switchgear, IDCS control room, mechanical room, office, restrooms, external transformer	Single-story, pre-fabricated steel frame with insulated metal siding with concrete pad for transformer	140 x 60	8,400
	On Pad Substation	Transformer, switchgear	Concrete pad	60 x 80	4,800
-	Standby Generators	Standby generators, above ground fuel storage	Concrete pad	100 x 30	3,000
-	Power Line	Power line	Aboveground	-	-
5008	Change House	Locker rooms, showers, restrooms, first aid, safety/fire control, garage, bullpen and training area	Single-story, pre-fabricated steel frame with insulated metal siding	110 x 127	13,970
-	Wastewater Pond (1)	Wastewater pond, waste water pipe	Pond is Polyvinyl Chloride double-lined with leak detection	200 x 200	40,000
-	Sanitary Sewer	Septic tank, leach field, sewer line	-	200 x 175	35,000
-	Water Supply	Well pump, booster pumps, raw water tank, firewater and potable water supply tanks, chlorine injection water lines	Pumps are in pre-fabricated steel building, tanks are on concrete support ring	-	-
-	Air Compressors	Air plant (compressors, cooler receiver, condensate tank and filter)	Concrete pad	100 x 55	5,500
-	Modular Office Complex	Modular office buildings, trailers with pads, parking, portable power system	All structures are pre-fabricated for temporary construction use	1 @ 60x60 1 @ 24x60 1 @ 168x60 13 @ 12x60	24,500

(1) Wastewater pond designed but not constructed. Currently, ESF uses a portable storage tank to collect wastewater

Power is made available from the south of Alice Hill via a single 69 kV power line with a thermal capacity of 20 MVA. It is anticipated that the power system will be upgraded from 69 kV/20MVA to 138 kV with a thermal capacity to be determined in the future. Design and installation information will also be provided in the future.

The ESF site includes the North Portal area and facilities, South Portal area, underground facilities including ramps and drift excavations, muck pile area, construction/laydown areas, and the roads and access roads associated with ESF operations. The main ESF drift starts at the North Portal, and extends underground to the South Portal. Material (muck) excavated from the subsurface is hauled to the surface and deposited at muck piles.

Some ESF facilities may be used for non-nuclear operations when the repository is built; however, if more reliable utility systems are required, the systems will be qualified and upgraded or demolished and replaced. Site areas may require re-compaction and stabilization of existing fill, and access roads will require upgrading.

4.2.3 Repository Surface Site Description

The planned repository site is shown in Figure 3 of Attachment IV, Repository Overall Site Plan. The four primary operational areas of the repository (the North Portal, South Portal, Shaft Operations, and Muck Storage) are described in the following sections:

4.2.3.1 North Portal

The North Portal area is approximately 154 acres in size, and is relatively flat, with about a 2 percent slope. Refer to Figure 4 in Attachment IV, North Portal Repository Area Site Plan. The area will include 19 structures in two primary areas: the RCA and the Balance of Plant (BOP) area. The RCA contains the nuclear facilities and systems that receive waste nuclear fuel from the off-site transportation system, place the waste in disposable containers, ship the empty transportation carriers, and collect and package site-generated low-level waste for disposal. The facilities include: the Carrier Preparation Building, where rail and truck carriers are prepared for receiving and shipping; the WHB, where shipping casks are unloaded and the waste is placed in DCs for emplacement; the WTB, where liquid and solid low-level waste is processed and packaged for off-site shipment; the Transporter Maintenance Building, where the site prime movers (SPMs) and underground transporters are serviced; and the Carrier Washdown Building (CWB), where road grime is removed from the carriers. The RCA surface area has a system of rail and road lines connecting the RCA facilities and parking, the BOP area, the North Portal, and Security Gate 3 (the rail/truck portal).

The North Portal does not have faults which have had significant displacements over the last 100,000 years. Quaternary faults do not lie under the waste handling facilities, and although tertiary faults exist, they don't present a seismic hazard. A portion of the North Portal is in a flood-prone area; however, the pad will be engineered such that it will not be affected by the PMF. The WHB and surface nuclear facility buildings will be set above PMF level. For this document (see Section 2.3, item B), the WHB and surface nuclear facility buildings will be engineered above PMF level, although alternative flood control measures are not ruled out if the repository is constructed.

The BOP area includes facilities to support surface and subsurface operations, including:

A. Administration Building - The building includes central site operations management and planning, transportation dispatch, office data systems, computer center, training center, and cafeteria.

B. Central Warehouse - The building maintains equipment spares, materials and consumables.

C. Central Shops and Motor Pool - The buildings support construction and repair operations associated with maintaining site facility and utility equipment and vehicles.

D. Fire Station and Medical Center - The building responds to fires, emergencies, and accidents associated with surface and subsurface operations.

E. Mockup Building - The building provides a material handling test bed for testing equipment and procedures associated with critical and complex cask, canister, and waste handling operations.

F. Security Stations 1, 2, and 3 - The buildings and stations provide access control and inspections for site personnel, visitors, and vehicles.

G. Wastewater Ponds - These installations collect wastewater pumped from sumps in the subsurface emplacement operations areas. At the South Portal the pond collects wastewater from the subsurface development operations areas.

In addition to the RCA and BOP areas, a Site Service area includes general parking and the Visitor Center, which provides educational and informational material about the repository.

4.2.3.2 South Portal

The South Portal Development area is located adjacent to the South Portal, and is the second largest surface facility area, covering approximately 40 acres with about 8 primary structures. The facilities of this area support the construction of the underground facilities. Facilities are provided for area personnel support, equipment maintenance, warehousing, material staging and laydown, security, transportation, and utilities.

4.2.3.3 Shaft Operations Areas

There are two types of ventilation shaft areas: those supporting Emplacement Ventilation Shaft Operations and Development Ventilation Shaft Operations. The actual number of shaft areas will be determined by the final subsurface thermal load design. As shown in this document, an Emplacement Ventilation Shaft area is about three acres in size, and is located at the north end of the subsurface facility. Two structures house the emplacement exhaust fan subsystem and exhaust fan maintenance support. Similarly, the Development Ventilation Shaft area is about three acres in size and is located at the south end of the subsurface facility. Emergency underground egress and inspection access, the development air supply fans, and associated electrical equipment are located in this area.

4.2.3.4 Muck Storage

The repository muck storage area is about 400 acres in size and provides space for 13 million cubic yards of muck excavated from the underground development drifts, as shown on Figure 3 of Attachment IV.

4.2.4 Concept of Site Operations

This section provides a concept of repository site operations, including; cask and waste handling; empty cask and container handling; site generated waste management; general supply; and personnel transportation. Refer to Table 4-2 for facility descriptions.

4.2.4.1 Waste Handling Operations

Truck and rail waste shipments are delivered by an off-site prime mover (OPM) to Security Station 3, where the shipment is inspected by security and health physics (HP) personnel. Security Stations 1, 2, and 3 are shown on Figure 4, Attachment IV. The shipment is then transported to the CPB with a Site Prime Mover (SPM), and the OPM waits for either a return shipment or other transportation dispatch orders. Cask/carriers are moved between RCA parking areas and facilities with an SPM. At the CPB, personnel barriers and impact limiters are removed and the casks are inspected. Contaminated casks can be cleaned by wiping, or transported to the WHB for decontamination. The carriers can also be sent to the CWBs to remove road grime. Prepared carriers are transported to parking or to the WHB carrier bay. In the carrier bay, the cask is removed from the carrier, and the carrier waits in the bay or is transported to parking to await loading of an empty cask. Section 4.4.2, Waste Preparation Systems, describes the waste handling operations in the WHB.

Table 4-2. Repository Surface Facilities at the North Portal

Site Map Ref.	Facility Name	Areas	Type of Construction	Principal Footprint Dimensions (ft)	Floor Space (ft^2)
Radiologically Controlled Area Facilities					
210	Airlock Building (AB)	North Portal airlock for personnel and an airlock for the subsurface transporter with trolley locomotives (front and rear).	Single story structural steel frame with insulated metal siding and roof.	50 x 150	7,500
211	Waste Handling Building (WHB)	Carrier bay, assembly transfer lines (pool area, assembly cell, DC load/decon cell), canister transfer lines (cask prep & decon, canister transfer), DC welding and storage cell, WP decon/transfer cell, WP transporter dock, WP remediation cell, airlocks, equipment transfer corridors, empty DC preparation area, operating galleries, access corridors, crane and welder maintenance bays, mechanical (HVAC) equipment rooms, waste handling control room, change rooms, laboratories, HP area, offices, and rest rooms, electrical switchgear, emergency generators	High-bay, structural-steel-frame receiving and shipping area; multilevel, reinforced-concrete hot cells; a steel frame, insulated-siding personnel annex	536 x 540	462,000 [1,3]
215-1	Waste Treatment Building (WTB)	Liquid radioactive waste treatment area, waste solidification area, solid radioactive waste treatment area and loading and unloading area, mixed waste storage, mechanical equipment rooms, control room, HP area, change rooms, offices and rest rooms	Two-story high bay; structural-steel frame. Insulated metal siding and roof	200 x 260	65,400 [4]
215-2	Carrier Preparation Building (CPB)	Staging/cask preparation area (i.e.,personnel barrier retraction, impact limiter removal/installation, and radiological inspection), office, restrooms, and change rooms.	Single-story structural steel frame with insulated metal siding and roof with high bay	120 x 160	20,000
220-4C	Transporter Maintenance Building (TMB)	Transporter storage, parts storage, minor maintenance service bays, wash/decon area, hazardous waste staging, HP area, lockers, showers, and offices	Single-story structural steel frame with insulated metal siding and roof	60 x 120	7,200
215-3 A&B	Carrier Washdown Buildings	Water washdown station	Single-story structural steel frame with insulated metal siding and roof	28 x 75	2,100

Table 4-2. Repository Surface Facilities at the North Portal, continued

Site Map Ref.	Facility Name	Areas	Type of Construction	Principal Footprint Dimensions (ft)	Floor Space (ft^2)
N120-1A	Rail Carrier Parking	Waste transportation railcar parking (125 railcars)	Rail yard asphalt	Note 2	Note 2
N120-1B	Truck Carrier Parking	Waste transportation trailer parking (35 trailers)	Asphalt	Note 2	Note 2
5008	Change House (existing)	Locker rooms, showers, restrooms, first aid, safety/fire control, garage, bullpen and training area	Single-story, pre-fabricated steel frame with insulated metal siding	110 x 127	13,970
5010	Switchgear Building with Transformer (existing)	Electrical switchgear, control room, mechanical room, office, restrooms, external transformer	Single-story, pre-fabricated steel frame with insulated metal siding with concrete pad for transformer	140 x 60	8,400
25-16	On Pad Substation	Transformer, switchgear	Concrete pad	60 x 80	4,800
N221-1	Standby Generators	Exterior diesel generators	Concrete pad	100 x 30	3,000
Balance of Plant Area Facilities					
220-3A	Security Station 1 (Main BOP portal)	Waiting room, badge distribution, communications center, records storage, security administration, offices, lockers and showers	Two-story, architectural-steel frame with insulated metal siding	50 x 80	8,000 [3]
220-3B	Security Station 2 (RCA/BOP portal)	Security check station, HP offices	Single-story, architectural-steel frame with insulated metal siding	65 x 80	3,000 [4]
220-3C	Security Station 3 (RCA truck/rail portal)	Storage for contamination equipment, security check station, HP offices	Single-story, architectural-steel frame with insulated metal siding	40 x 70	2,800
220-5A	Admin. Building	Offices, laboratories, training rooms, and mechanical areas	Two-story, architectural-steel frame with insulated metal siding	100 x 220	44,000 [3]
220-5B	Food Service Facility	Kitchen, lunchroom, serving area, food/supplies storage, and rest rooms	Single-story, architectural-steel frame with insulated metal siding	60 x 180	11,000 [5]
220-5C	Training Auditorium	Auditorium	Single-story, architectural-steel frame with insulated metal siding	25 x 40 50 seat capacity	1,000
220-1B	Medical Center	Examination rooms, X-ray, medical labs, waiting room, ambulance garage, mechanical rooms, and offices	Single-story, architectural-steel frame with insulated metal siding	40 x175	7,000 [5]

Table 4-2. Repository Surface Facilities at the North Portal, continued

Site Map Ref.	Facility Name	Areas	Type of Construction	Principal Footprint Dimensions (ft)	Floor Space (ft^2)
220-2	Fire Station	Apparatus room, communications room, equipment storage, firemen's quarters, offices, lunchroom, lockers and showers	Single-story, architectural-steel frame with insulated metal siding	85 x 100	7,600 [4]
220-22	Computer Center	Computer room, mechanical equipment areas, offices, and central monitoring center	Single-story, reinforced-concrete structure	60 x 65	4,000
220-7	Central Warehouse	Storage space, receiving an shipping dock, offices, lunchroom, lockers and showers	Single-story, (clear height 23 feet) architectural-steel frame with insulated metal siding	200 x 285	57,000
220-4A	Central Shops	Craft shops (electrical, mechanical, plumbing, welding, automotive, machining), central covered work area (not included in floor area), offices, lunchroom, first aid, lockers	Single-story, architectural-steel frame with insulated metal siding	60 x 40 each	28,800 [5] total
220-4B	Motor Pool and Facility Service Station	Dispatch office, carwash, fuel storage, light maintenance, parking (heavy maintenance is off-site)	Single-story, architectural-steel frame with insulated metal siding	30 x 40	1,200
220-6	Mockup Building	High-bay mockup room, classrooms, and offices	Single-story, architectural-steel frame with insulated metal siding	72 x 120	8,640
N221-2	Utility Building	Water chillers, cooling tower water make-up treatment, plant and instrument air compression, hot water boilers	Single-story, architectural-steel frame with insulated metal siding.	100 x 220	22,000
Site Service Facilities					
N120-1C	General Parking	Car parking lots, bus loading areas, bus parking lot	Asphalt	250 x 250	62,500
N120-1E	Cooling Tower	Cooling tower, cells, pump basin			
N221-3	Visitor Center	Theater, meeting rooms, reception area, food service, offices, restrooms	Two-story, architectural - steel frame with glass	150x 150	14,300 [4]

Source: *Repository Surface Design Site Layout* Analysis (CRWMS M&O 1998c, Table 7-2, pp. 25 to 28) except as noted.

Notes:

1. Represents the most advanced design (VA), (DOE 1998b, Volume 2, Section 4.1, pp. 4-1 to 4-38)
2. Included within the North Portal area. Not yet sized.
3. Square footage on multiple floors, which may result in more square feet than footprint indicates.
4. Building is irregular shape, resulting in less usable square feet than footprint indicates.
5. Square footage is approximate.

4.2.4.2 Empty Cask Operations

Empty casks (returned from unloading in the WHB) are loaded onto carriers in the WHB carrier bay. An SPM transports the cask/carriers to the CPB where the impact limiters and personnel barrier are installed. The cask/carriers are then hauled by SPM to the RCA and configured into unit trains prior to shipment.

A portion of the commercial SNF will be received in DPCs packed inside a transportation cask. The waste preparation systems will cut open the DPCs to remove the waste (it is assumed that the majority of DPCs will have to be cut open), after which the empty DPC will be overpacked and prepared for shipment to an off-site facility for disposal or recovery. Empty DPC overpacks will be delivered to RCA Security Station 3 by OPM, then to an RCA parking area. The SPM will move the overpack to the WHB when a full DPC is ready for unloading. After the DPC has been opened and its waste removed, the empty DPC is loaded into the overpack and transported back to the carrier bay, where both are loaded onto a carrier for off-site shipment (disposal or recycle).

4.2.4.3 Empty DC Operations

Empty DCs are delivered from the fabricator by train to RCA Security Station 3 (see Attachment IV, Figure 4, North Portal Area Site Plan). An SPM moves the DC/Carrier to the empty DC preparation area in the WHB. The DC is removed from the carrier and prepared for waste loading by the DC Handling System (Section 4.4.2.5).

4.2.4.4 Site-generated Waste Management Operations

Low-level radioactive waste (LLW), hazardous and mixed waste are generated in the RCA facilities and operating areas. Solid and liquid LLW is accumulated at the point of generation, treated, and packaged in drums. Empty waste drums are stored in the WTB area and provided to other RCA areas as needed. Refer to Section 4.4.3, Site-generated Radiological Waste Treatment System, for a detailed description. Hazardous waste drums are collected, packaged, and shipped to an off-site, licensed disposal facility. Refer to Section 4.4.8, Non-Radiological Waste Systems.

4.2.4.5 General Supply Operations

General supplies required by North Portal operations will be brought by truck through Security Station 1 in the BOP area and stored in the Central Warehouse. The materials, parts, and equipment will be transferred by truck from the warehouse to other facilities in the BOP and satellite warehousing at the South Portal, shaft areas, and the RCA. Materials to the RCA will pass through Security Gate 2. Refer to Section 4.4.6.2, Maintenance and Supply System.

4.2.4.6 Personnel Transportation Operations

Site personnel will arrive at the site in buses and personal vehicles, which will be parked outside the BOP area. Personnel working in the North Portal will enter the BOP through Security Station 1. Personnel working in the RCA will then pass through Security Station 2.

4.3 NORTH PORTAL SURFACE FACILITIES

The North Portal surface facilities comprise a Radiologically Controlled Area, which includes facilities associated with waste shipping, receiving, and waste preparation, and Balance of Plant operations. Table 4-2, Repository Surface Facilities at the North Portal, lists the primary North Portal facilities by name, and summarizes their characteristics. Additional descriptions for selected facilities are provided in subsequent parts of Section 4.3.1. The table and descriptions in the following sections indicate reference numbers included on the North Portal Repository Area Site Plan, Figure 4 of Attachment IV. The systems that operate within these facilities are described in Section 4.4.

4.3.1 Major RCA Facility Descriptions

The RCA facilities are dedicated to nuclear waste shipping, receiving, and transport operations within the RCA, including unloading nuclear waste from casks, storing the waste, loading waste into DCs, and loading underground transporters for emplacement. The primary RCA facilities and characteristics are summarized in the Radiologically Controlled Area section of Table 4-2.

4.3.1.1 Carrier Preparation Building (215-2)

The CPB houses the CPB material handling system, which is required to prepare incoming carrier/cask configurations for unloading at the WHB and off-site shipment. Refer to Figure 5 of Attachment IV, Carrier Preparation Building Plan, Elevation and Section. The CPB structure has a net floor area of about 20,000 square feet, the majority of which is allocated to four parallel roadway/tracks that can accommodate two carriers each. The facility includes the utility, support, and safety systems required to support carrier/cask operations and protect personnel. The ventilation system utilizes overhead and/or wall-mounted radiant heaters, with cooling provided from roof-mounted fans.

4.3.1.2 Waste Handling Building (211)

The Waste Handling Building (WHB) provides the structures, controlled areas, and accesses required to house and operate the waste preparation systems, protect operating personnel, and maintain radiological confinement. Integral to the facility structure are the essential waste preparation systems, including the Carrier/Cask Handling System, Assembly Transfer System, Canister Transfer System, DC Handling System, and Waste Package Remediation System. The associated operating and equipment areas for these systems are described in subsequent sections. Essential support systems include the WHB electrical, fire protection, radiation monitoring, and ventilation systems described herein. Ancillary support systems include security, communications, alarm and public address, potable and chilled water, sanitary waste, low-level waste, effluent, air and vacuum, waste handling pool, decontamination, facility monitoring and control, and the supporting repair and calibration shop, office, and other support areas.

4.3.1.2.1 Facility Layout

The WHB is located close to the North Portal within the RCA. The structure establishes the operating and equipment areas; the boundaries required for safe handling of shipping casks, waste, and DCs; and WHB office and support operations. Refer to Figures 6 through 16 of Attachment IV, Waste Handling/Waste Treatment Building Floor Plans, Sections, and Elevations.

The structure has 462,000 square feet of net (useable) operating area, with two floors located below grade and four above. The facility has a variety of floor areas and area heights that range from 9 feet to over 120 feet, with taller heights required for the waste handling pool, high vertical lift areas, and equipment transfer corridors. The operating areas for the primary waste handling systems use about 33 percent of the useable space. Primary and facility support areas (operating galleries, equipment transfer corridors, and support equipment rooms) each use about 13 to 15 percent of the available floor space. The ventilation system equipment requires about 28 percent of useable facility space. The remainder of the floor space is taken by offices, lockers, and minor support areas. Building circulation pathways will accommodate the maximum number of WHB personnel, including increased personnel present during shift changes in the currently planned three shift per day operation. Hatches, structural and shielding walls, and a ventilation system are provided.

4.3.1.2.2 Building Structure

The primary factor affecting the size of the WHB structural system is the use of thick (up to five feet) concrete walls as radiation shields. Based on the source terms and occupancy data, some process areas require maximum thickness, while somewhat less may be sufficient elsewhere as determined by radiation source strength and the nearness of approach and length of stay of personnel. The dry cell delid/transfer area, assembly cells, DC load and decon cells, and the DC welding/staging areas will require concrete walls about 5 feet thick. Other areas of less radiation at the upper elevations, carrier preparation, airlocks, etc. will have walls with a variety of thickness ranging from 1 to 3 feet thick. The roof structures will act as both shielding and tornado missile barriers. Radiation shielding requirements decrease with distance from the floor, and the roof structure is estimated to be a concrete slab 8 to 10 inches thick supported by steel beams and concrete walls.

Secondary factors that impact the building structure and foundation loads are the heavy duty overhead cranes, with capacities of up to 140 tons, and 90- to 140-ton concentrated loads on the operating floor from casks and DCs on transfer carts.

The pool area of the wet process lines consists of three water pools with up to six cask preparation pits. The water pools will require thick (approximately 4 ft) concrete walls lined with stainless steel plate to prevent loss of water. Wall thickness will be based on lateral loads resulting from hydrostatic pressure, earthquakes, cask drops, and other accidents. The stainless steel liners provide primary containment and have installed leak detection systems. The concrete pool walls will serve as secondary containment.

Because the waste handling process areas will each incorporate sufficient radiation shielding to permit operating personnel to carry out their jobs safely, much of the WHB external wall structure has no allocated shielding function. As a result, 80 percent or more of the structure's external walls will be constructed of structural steel covered with metal siding.

The WHB cold support facility will consist of the administrative offices and laboratories with no radiation shielding requirements. The first floor will be a steel framed structure with sheet metal siding, and will be slab on grade. The second floor concrete slab and metal deck roof will be supported by steel beams and columns. The DC preparation facility will be an industrial area without radiation shielding requirements, and will be constructed with light steel framing with sheet metal siding. These facilities will be separated from the WHB primary structure to avoid interaction during an earthquake.

4.3.1.2.3 Operating and Equipment Areas

The WHB operating and equipment areas and rooms are identified in Figures 6, 7, and 13 of Attachment IV, Waste Handling/Waste Treatment Building Sections and Floor Plans. The Carrier Bay area contains the Carrier/Cask Handling System required for cask receipt and shipping. The assembly transfer area contains the Assembly Transfer System, including dry cells for cask preparation; pools for cask and canister opening, waste unloading and staging; and hot cells for assembly drying and DC loading.

The canister transfer area contains the Canister Transfer System, including dry cells for cask preparation, cask opening, canister unloading, and DC loading. The DC handling area contains the DC Handling System, including empty DC preparation and hot cells for DC welding, inspection, and staging; decontamination; and transfer.

The waste preparation systems are described in detail in subsequent sections. Laydown areas are provided for components, fixtures, and tooling during normal and off-normal operations. Operating galleries and control rooms are located to optimize handling system control and viewing. Hot and cold equipment servicing rooms and transfer corridors are located adjacent to, or in proximity to, waste handling areas to support system maintenance.

Security and health physics (HP) areas are integrated into the building including offices and operating stations required for surveillance, access control, radiological support, and HP surveys. Office areas are provided to support plant management, logistics, repair engineering, records and document control, quality assurance (QA), regulatory, and clerical activities.

4.3.1.2.4 WHB Electrical System

The WHB electrical system performs the function of conditioning, distributing, monitoring, and controlling AC power to all waste handling facility users. The system consists of the transformers, switchgear, controllers, uninterruptible power supplies, and distribution subsystems required to power facility lighting, ventilation, instrumentation, process, and mechanical equipment. Standby power is continuously maintained (uninterruptible power source) to the facility emergency lighting and other safety related systems, including systems that require controlled shut down. Uninteruptable power is provided to subsystems that maintain status and safety monitoring of the facility. Emergency power generation is provided for WHB safety class systems from a diesel generator located within the facility to supply nuclear safety class ventilation, pool cooling and other related systems. The power duration will be sized for 24 hours. Additional emergency and uninterruptable power supply is provided at the site surface for other safety class systems at the site, including the security, emergency response, and communications systems.

The WHB electrical system distributes and controls primary and standby power with a dependability compatible with waste handling facility reliability objectives. Standby and uninterruptible power will be provided to performance standards compatible with equipment specifications, and will be sustained for a period that is reasonable compared to typical outage durations, and the facility support requirements.

4.3.1.2.5 WHB Fire Protection System

The WHB fire protection system performs the function of detecting and automatically suppressing fire in the WHB. The fire detection subsystem automatically monitors and annunciates fire and potential fire conditions based on smoke, heat, and rate of temperature rise conditions. The system alerts facility personnel, the fire house, site security, and emergency response stations of the fire conditions, and initiates the facility fire suppression subsystem in the affected areas. Smoke and heat detection, fire pull boxes and alarm instrumentation are installed throughout the facility in accordance with national and local fire codes and radiological facility standards. The suppression system automatically initiates wet sprinkler or water deluge equipment installed where fire or smoke is detected. The system includes dry chemical extinguishers, fire hoses, and pull box stations located throughout the facility.

The fire protection system will provide timely and reliable initiation of fire suppression and alarm equipment and will provide accurate location of the fire to emergency response and support personnel. The system operates in coordination with the facility ventilation system to detect smoke and fire in specific areas and to minimize the conditions through controlled ventilation. The detection and alarm system is powered from an uninterruptible power supply.

The system includes automatic audible and visual fire annunciation, manual alarm initiation and suppression equipment, a fire alarm system, and posted instructions for the safe and controlled egress of facility personnel. The system is installed in all facility operating and equipment areas and interfaces with the site fire water system. In radiation controlled areas and areas where there is a potential for contamination, sprinkler water from the automatic fire suppression system will be collected by floor drains and routed to a holding tank. If contaminated, it will be treated before disposal.

4.3.1.2.6 Waste Handling Facility Radiological Monitoring System

The WHB radiological monitoring system will monitor, display, annunciate, and report on the radioactivity levels in the facility equipment and operating areas, exhaust air, wastewater, and facility effluents during operations under normal and off-normal conditions, including facility egress areas. Radiation and contamination levels will be monitored continuously and alarmed when safe levels are exceeded. Radiation data will be trended to provide advance warning of excessive radiation levels in or around the facility. The system will provide central WHB and site (Central Monitor and Control) display of radiation levels, and visible and audible annunciation of unsafe radiation levels and trends. Essential radiation data and alarms will also be provided to central alarm, security, HP, and emergency response systems.

Radiation monitors in the operating and equipment areas, ventilation system, exhaust stack, assembly pool, continuous air, and criticality radiation monitors will operate independently and communicate with the facility-wide radiation monitor and control system. The detectable radiation levels of the instruments will be set to ensure that personnel are safe when occupying an area for the planned durations. Radiation trending will track unsafe increases from the expected radiation levels, accumulations, or rates, and will provide warnings and advisories before unsafe levels are reached. Exceeded limits will be audibly and visually alarmed, recorded and time tagged,and the system reaction time will be set to provide the earliest valid warning. The detection instruments will perform self tests on operating status and calibration, record the results, and report anomalies and failures. The system will interface with the health safety system, which will maintain the personnel dosimeters and portable and hand and foot radiation monitors to monitor individual exposures within the facility.

4.3.1.2.7 Waste Handling Building Ventilation System

The WHB ventilation system supplies fresh air and controls the environmental conditions to equipment and operating areas within the facility. The system operates in conjunction with the facility physical barriers to control the air flow and pressures within the facility, and filter the air to prevent the spread of radioactive contamination, exposure to personnel, and releases to the accessible environment. Airborne radioactive and hazardous release rates are controlled within environmental standard limits, and releases to the personnel occupancy zones are controlled to below the health safety standards.

The ventilation system controls three confinement zones: the primary zone, which is normally contaminated; the secondary zone, which has potential for contamination; and the tertiary zone, which is normally free of radiation or contamination. The system maintains the pressure differentials between the primary zone (low pressure relative to the secondary zone), secondary zone (negative pressure relative to the outside environment), and tertiary zone (low pressure relative to the outside environment, but higher than the secondary zone). Air flow is therefore controlled from the areas of least radiation potential toward those of higher potential. Each zone consists of an independent ventilation system, with separate instruments and controls, integrated with a central ventilation control system to maintain coordinated operation. Refer to Figure 17 of Attachment IV, WHB-HVAC Flow Diagram. The supply air segment of each ventilation system consists of a missile-protected outside air intake; air handling unit with filters, heat and cool units, and sprayers; and supply air fans, supply air ducts, and control dampers to the respective areas. The exhaust air segment of the ventilation systems is provided for contamination confinement, and consists of the exhaust air ducts, HEPA filter units, exhaust air fans, and tornado dampers exhausting to a single WHB exhaust air stack.

Room temperature and air flow are maintained to prescribed equipment criteria, occupancy comfort, and safety limits. Winter humidification will not be provided unless substantiated by engineering computation or records that the relative humidity will be less than 30 percent. Summer humidification for personnel comfort will not be provided. The cooling system will be designed to maintain the space relative humidity condition through the normal cooling process and will not have controls to limit the maximum relative humidity unless project-specific criteria dictate otherwise. The system will detect the presence of hazardous conditions (such as radiological release, hazardous gas, or smoke) and control the ventilation in the area. Following unsafe conditions resulting from natural and induced events such as seismic events, fires, and power outages, the areas expected to be designated as safety class are provided with required air flow by a dedicated emergency HVAC exhaust system designed with adequate support equipment, HEPA filters, and emergency electric power. The emergency HVAC system is located in a hardened area of the facility and ensures continuous inward ventilation flow to maintain the desired negative pressure differentials.

4.3.1.3 Waste Treatment Building

4.3.1.3.1 Facility Description

The WTB houses the site-generated radiological waste handling system, which collects and prepares any site-generated low-level radiological solid, liquid, and mixed waste for disposal. The system controls the collection of the liquid LLW and treats it prior to packaging it for disposal. Solid LLW is also collected, condensed, and repackaged for disposal. The waste streams are anticipated to be of low enough radioactivity that the only feature required to meet NRC exposure control requirements would be shielding at process equipment such as the recycle liquid evaporator and ion-exchange equipment, where waste stream radionuclides are concentrated. The system can also stage some solid and liquid mixed waste and transport the waste to disposal. The building structure is sited adjacent to the WHB carrier bay. The facility houses the handling equipment, process tanks, piping, instrumentation, offices and personnel involved in the collection of non-recylable liquid and solid waste from the WHB wet and dry cask/canister preparation processes, and the DC handling process. Refer to Figures 6 through 16 in Attachment IV, Waste Handling/Waste Treatment Building Floor Plans, Sections and Elevations. The system also contains equipment, tanks, and piping for dewatering of spent resin from the three pools in the WHB if the radiation levels permit. The building is a two-story, structural steel frame, high-bay industrial structure. The main operating floor is a slab on grade. The superstructure is structural steel, braced frame with metal siding and metal deck roof. Support personnel offices are located on the ground floor. An elevated floor or mezzanine is located above the personnel offices for the building mechanical equipment. The WTB and the WHB are separated by a seismic joint to prevent structure interaction between the two different framing systems during an earthquake.

The facility is lightly loaded, since there are no overhead cranes, and all major process equipment is sitting on the ground floor slab. Because the building columns have relatively light loads, individual spread footings can be assumed for the column foundations. Based upon the geotechnical reports, low allowable bearing pressures should result in acceptable settlements of about 3/4".

The building includes areas for security portals and offices, general offices, parts and materials storage, change rooms, lunchroom, management and administration, process control, fork lift staging, HP, QA, and instrument calibration. The WTB facility characteristics are summarized in Table 4-2, and are described in the following sections.

4.3.1.3.2 Waste Treatment Building Ventilation System

The WTB ventilation system supplies air and controls the operating zone pressure and environmental conditions to equipment and personnel areas within the facility. The system maintains the minimum required pressure differentials in the LLW process and handling areas to facilitate controlled air flow, and controls the temperature inside the facility to be within prescribed equipment and occupancy safety limits. The WTB ventilation system design and operation is similar to the WHB system previously described ; however, there is no primary ventilation zone, the equipment is not safety class, and hardened ventilation equipment rooms and emergency power generation are not provided. Refer to Figure 18 in Attachment IV, WTB-HVAC Flow Diagram. Airborne contamination is removed, and air flow is controlled away from penetration barriers to protect personnel from radiation exposure and minimize inadvertent release of radiological particles in populated areas. The system controls all ventilated areas to protect against unsafe conditions resulting from natural and induced events such as seismic events, fires, and power outages.

4.3.2 Balance of Plant Facilities

BOP facilities are located in the BOP area adjacent to the RCA. The facilities provide non-radiological support to surface and subsurface operations, including management and administration, warehousing, maintenance, fire, medical, utility (including fuel and steam generation), security, and mockup and testing. The primary BOP facilities are named and their characteristics summarized in Table 4-2. The table and descriptions in the following sections indicate reference numbers included on the Site Plan, Figure 4 of Attachment IV.

4.3.2.1 Administration Building

The Administration Building includes the site operations management and planning offices, waste transportation dispatch offices, site training offices and facilities, computer center, and cafeteria. The transportation dispatch center maintains communication with the cask carrier truck and rail fleet, and integrates the waste dispatch and planning operations with the site management and planning operations in the same building.

The computer center is a hardened facility that houses the central computers for site planning and management, dispatch operations, site supervisory control (surface utility and subsurface operations), office and data systems, and for site/off-site communications computers and equipment. The training center provides the class rooms, training equipment, offices, and records centers required to train personnel, and to plan and maintain a robust training and certification program.

4.3.2.2 Fire Station and Medical Center

The fire station is a major element of the emergency response system (Section 4.4.4.2), and responds to fires and accidents at or near the repository to treat personnel, and stabilize accident conditions to normal. The station maintains fire and rescue vehicles, equipment, and trained professionals required to respond to fire, including radiological, mining, industrial, and accident events on the surface and subsurface. The Medical Center is located adjacent to the fire station, and maintains a full time doctor, nurse, and the medical stores required to treat injuries and illnesses. The fire station and Medical Center maintain the communications systems required to coordinate with off-site professional medical, fire, rescue, mining, and radiological emergency organizations.

4.3.2.3 Central Shops and Motor Pool Facility

The shops provide a basic machining, carpentry, plumbing, mechanical, and electrical repair capability to support general site facility and utility repair and improvement operations. The motor pool provides for general repository vehicle maintenance and fueling.

4.3.2.4 Central Warehouse

The warehouse building maintains an inventory of critical equipment spares, materials and consumables required to maintain operations.

4.3.2.5 Mockup Building (220-6)

The mockup building houses a suite of critical material handling systems required to test functional and performance aspects of the operational material handling systems, develop material handling procedures, support development of new handling equipment and upgrades to existing equipment, and train personnel. Wet and dry waste handling test beds will be provided.

4.3.2.6 Utility Building

The Utility Building is located next to the cooling tower, and consists of a mechanical equipment room, an office, and restrooms. The equipment room consists of systems for cooling water, cooling tower water treatment, and compressed (industrial) air systems. The cooling water system includes water chillers, pumps, and compression tanks to supply chilled water to North Portal facility HVAC air handling units. The water treatment system treats makeup water for the cooling tower, and the air system provides industrial air distributed to North Portal facilities for tooling, pneumatic operators, and general use.

4.3.2.7 Fuel Supply System

The fuel storage facility (FSF) will provide storage and distribution of fuel to surface waste handling users, the primary user being the steam plant located in the utility building. The type of fuel is not yet determined. The system is not yet designed, but it is expected that a 250,000-gallon main fuel tank will be located at a rail and road spur, providing about two weeks of fuel supply. The tank will be single shell construction, and will have a confinement base that can handle the required percent of fuel due to leaks. A local instrument station will include the instrumentation, pumps, and fittings to fill and empty the tank and to perform leak detection and alarm. The main tank will automatically provide fuel to a day tank (approximately 15,000-gallon) located near the utility building. The day tank will be single shell construction, and will have a confinement base that can handle the required percent of fuel due to leaks. A local instrument station will include instrumentation, pumps, and fittings to fill and empty the tank, automatically maintain fuel to the steam system, and perform leak detection and alarm.

4.3.2.8 Standby Generators

Standby power is provided by diesel powered generators at various locations at the repository, including the subsurface exhaust shafts, the WHB, and for site security and safety systems. Emergency power is provided to the WHB ventilation fans from redundant diesel generators located in the hardened WHB structure, and ensures facility exhaust flows from operational zones to the primary confinement zone and out through the exhaust stack following loss of utility power.

Security/safety systems emergency power is provided for site safety, emergency, and security equipment, lighting, and communications equipment. Electronic safety equipment, including security, emergency response, and communications controls, is powered by uninterruptible power supply (UPS) systems and backed up by emergency generators, where required. Standby power is also available to support subsurface safety systems, including fire, lighting, communications, and other safety equipment. The surface emergency and standby generators are as follows, not including the subsurface emergency generators at the emplacement shaft and development shaft:

Function	Type	Generator Power	Supply	Location
WHB Ventilation	Emergency	To be determined	Diesel/Capacity to be determined	WHB
WHB Pool Cooling	Emergency	To be determined	Capacity to be determined	WHB
Security	Emergency	To be determined	Diesel/Capacity to be determined	To be determined
Automated Data Processing/ Communications	Emergency	To be determined	Diesel or UPS Capacity to be determined	To be determined
Subsurface	Standby	To be determined	Diesel/Capacity to be determined	To be determined

4.3.2.9 Balance of Plant Facilities HVAC

The HVAC for the BOP facilities provides heating, cooling, and ventilation for the health, safety, and comfort of personnel and the protection of equipment. The ventilation systems shall be of industrial grade.

The ventilation rates in the buildings and rooms will meet the requirements of the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 62, *Ventilation for Acceptable Indoor Air Quality.*

4.3.3 Site Service Facilities

4.3.3.1 Visitor Center

The Visitor Center provides personnel, presentation areas, equipment, and materials required to educate visitors on the operation of the repository.

4.4 SYSTEM DESCRIPTIONS

This section describes the primary systems associated with the waste handling operations at the North Portal, and the site utility, waste, and transportation systems that support surface and subsurface area operations, including areas out to and beyond the site perimeter. Systems in the North Portal area include the cask/carrier shipping and receiving systems, waste preparation systems, site-generated radiological waste handling systems, and the management and administration systems. Facilities associated with these systems are described in Section 4.3, North Portal surface facilities. Also described are the site utility systems, safety and security systems, transportation systems, and the hazardous and nonhazardous waste disposal systems, which include equipment and facilities located at various areas of the site and support most operations.

4.4.1 Carrier/Cask Shipping and Receiving Systems

The Carrier/Cask shipping and receiving system receives cask and DC shipments by rail and truck, provides parking for carriers and prime movers, provides carrier transportation in the RCA, prepares cask shipments for handling at the WHB, and prepares empty carriers for off-site shipment. The system is located within the RCA. Refer to Figures 4 and 19 of Attachment IV, North Portal Area and MFD-Waste Handling Overview. The system consists of the carrier/cask handling system (CCHS); the CPB, including CPB material handling system; and the CWBs. The system will receive a peak annual rate of approximately 1500 rail and 240 truck shipments, including waste, empty DCs, and DPC overpacks. Off-site shipments include the empty rail and truck cask/carriers and the overpacked empty DPCs, as previously defined.

The system includes the rail and road systems, site prime movers (SPMs), and equipment required to engage and disengage carriers and movers and for transportation to and from Security Gate 3, parking, the WHB, the CPB, and the CWB.

4.4.1.1 Carrier/Cask Transport System

The carrier/cask transport system includes the roads and rail systems, parking areas, SPMs, and equipment required to engage and disengage carriers from prime movers, park carriers and prime movers, and transport the carriers between Security Gate 3, parking, the CPB, and the WHB. Refer to Figures 19 and 20 in Attachment IV, MFD-Waste Handling Overview and MFD-Carrier/Cask Transport System. Incoming shipments arrive at Security Station 3, where they are inspected and the off-site prime movers (OPMs) are parked. The carrier is transported by SPM to parking, the CPB or, in the case of DC shipments, to the WHB. The CPB provides the facility and material handling systems required to receive and prepare multiple truck and rail carrier/cask configurations for unloading and off-site shipment.

Carriers with empty casks, or casks requiring remediation, are also transported to the CPB, where they are prepared for off-site shipment. The carriers are then inspected, mated with an OPM, and shipped. The CWBs provide the carrier washdown equipment required to remove road grime before handling at the WHB. The system provides the rail switching, safety systems, and truck turn-around required for carriers to be managed in and out of parking, the security gate, and the facility preparation and handling bays.

The system is integrated with the CPB and WHB preparation and loading/unloading stations to minimize carrier/cask wait time. Traffic control and safety systems are provided to U.S.

Department of Transportation (DOT) standards and are integrated with the general site transportation system that transports personnel, materials, and equipment to and from the RCA facilities. Although the design is notional, heavy haul shipments (if employed) will be unloaded at a staging area outside the RCA, and the waste loaded onto rail that is compatible for shipment on-site (in the RCA).

4.4.1.2 Carrier Preparation Material Handling System

The carrier/cask transport system (previous section) moves rail and truck cask configurations to and from the CPB and the security gate, parking, and the Carrier/Cask Handling System at the WHB. Refer to Figures 19 and 21 of Attachment IV, MFD-Waste Handling Overview and MFD-CPB Material Handling System. CPB preparation operations include moving a loaded carrier/cask ensemble into an available preparation bay with an SPM, performing radiation surveys, removing the personnel barrier, inspecting for contamination, measuring the cask temperature, and removing the impact limiters. The prepared carrier/cask can be transported to the WHB for unloading when a position is available, or sent to parking. The SPM can be freed for re-use when available.

Truck or rail carriers with empty casks, or casks requiring service, are prepared for off-site shipment by installing impact limiters, performing cask surveys, and installing personnel barriers. Four parallel preparation lines operate concurrently to handle the canistered waste shipment schedules. Each line has two preparation bays, each of which can accommodate truck and rail shipping and receiving. One remotely operated overhead bridge crane and gantry crane is provided for each pair of lines, servicing four preparation bays. Remotely operated support equipment includes a gantry-mounted manipulator, and tooling and fixtures required for removing/installing barriers and impact limiters. Remote handling equipment is designed for operator safety, to minimize radiation exposure, facilitate maintenance, and to support normal and off normal recovery operations.

4.4.2 Waste Preparation Systems

The WHB provides the structures, controlled areas and accesses required to house, operate, and support the waste preparation systems, protect operating personnel, and maintain radiological confinement. Refer to Section 4.3.1.2, Waste Handling Building. Integral to the facility structure are the essential waste preparation and handling systems, including the Carrier/Cask Handling, Assembly Transfer, Canister Transfer, and DC Handling Systems which are described in the following sections. Refer to Figure 19 of Attachment IV, MFD-Waste Handling Overview.

4.4.2.1 Carrier/Cask Handling System

The Carrier/Cask Handling System receives rail and truck carriers containing loaded shipping casks and DPC overpacks from the carrier/cask transport system (Section 4.4.1.1). Refer to Figures 19 and 22 of Attachment IV, MFD-Waste Handling Overview and MFD-Carrier/Cask Handling System. The Carrier/Cask Handling System unloads the casks from the carrier, and transfers the casks to the Assembly or Canister Transfer System, which are described in subsequent sections.

The system also receives empty casks from the Assembly and Canister Transfer Systems, and non-disposable canister overpacks from the Assembly Transfer System. The system loads empty shipping casks onto carriers for transfer to the CPB where they are prepared for off-site shipment (Section 4.4.1.2). Empty or full damaged or off-normal casks are loaded onto carriers for transfer to the CPB, where they are prepared for shipment to a Regional Service Agent (RSA). Non-disposable canister overpacks are shipped to an off-site recycling or disposal facility.

The system is housed in the WHB Carrier Bay, which provides four loading/unloading stations. Two rail/truck lines enter from one end of the bay. The carrier cask transport system provides the SPMs, rail switching, and turnaround so that carriers are moved in and out of the bay, minimizing wait time. The system includes a carrier bay crane and two gantry-mounted manipulators, which can service casks from any of the loading/unloading stations in the bay. The support equipment includes a suite of cask lifting yokes, tooling, and fixtures required to support cask loading and unloading.

4.4.2.2 Assembly Transfer System

The Assembly Transfer System receives rail and truck shipping casks, unloads spent nuclear fuel assemblies (SNF) and non-disposable canisters from the casks, opens non-disposable canisters, loads SNF assemblies into DCs, and prepares empty casks and non-disposable canisters for off-site shipment. Refer to Figure 23, MFD-Assembly Transfer System (Assembly Cask Unloading); Figure 24, MFD-Assembly Transfer System (DPC Unloading); Figure 25, MFD-Assembly Transfer System (Empty Cask Shipping); Figure 26, MFD-Assembly Transfer System (Empty DPC Shipping); and Figure 27, MFD-Assembly Transfer System (Staging and Loading), in Attachment IV.

Cask unloading operations begin with cask cavity sampling, venting, cool down, and lid unbolting. Casks containing bare SNF assemblies are loaded into a pool and the lid is removed. Casks containing non-disposable canisters have the lids removed, then the canister is sampled, vented, and cooled before being loaded into a pool with the cask.

Pool operations include: placing non-disposable canisters in an overpack, cutting the canister open, unloading assemblies from casks and canisters, staging assemblies, and transferring assemblies to hot cells for drying. Empty casks and lids are returned to cask preparation to prepare them for reshipment, and non-disposable canisters are loaded in an overpack for off-site disposal. DC loading operations include removing the assemblies from wet storage, drying the assemblies, loading them into a DC, and installing a seal lid. The loaded DCs are then decontaminated, inerted, and prepared for DC welding.

Three identical assembly transfer lines are provided in the WHB. The lines can operate concurrently to handle the assembly transfer throughput and support maintenance operations. Each cask unloading area contains an airlock, one or more cask preparation pits, and a cask unloading pool.

The handling equipment includes cask transfer carts, overhead bridge cranes, a cask cooldown system, spent fuel handling machines, and non-disposable canister lid severing tools. The wet assembly transfer areas include wet staging pools with assembly transfer canals, wet staging racks, assembly baskets, and wet assembly transfer carts. The dry DC loading area contains assembly drying vessels, a DC loading cell, and a DC decontamination and inerting cell. The area is supported by handling equipment consisting of a dry assembly transfer machine, an overhead bridge crane, manipulators, and decontamination and inerting equipment. Various manipulators, lifting fixtures, carts, and tooling are provided for assembly basket, DC, and assembly handling.

4.4.2.3 Canister Transfer System

The Canister Transfer System receives rail shipping casks containing large and small DISPCs, unloads the canisters from the casks, stages the canisters as required, loads them into DCs, and prepares the empty casks for re-shipment. Refer to Figures 28 and 29 in Attachment IV, MFD-Canister Transfer System (Large Canister) and MFD-Canister Transfer System (Small canister).

Cask unloading begins with cask inspection, sampling, and lid bolt removal operations. The cask lids are removed, and the canisters are unloaded. Small canisters are loaded directly into a DC, or are stored until enough canisters are available to fill a DC. Large canisters are loaded directly into a DC. Shipping casks and related components are decontaminated as required, and empty casks are prepared for reshipment.

Two identical remotely operated canister transfer lines are provided in the WHB. The lines are operated concurrently to handle canistered waste transfer throughput, and support canister system maintenance. Each cask preparation area includes an airlock, cask preparation station, and cask decontamination station. Remote handling equipment consists of cask transfer carts, cask prep manipulators, and equipment required to perform cask unbolting, venting, lid removal and decontamination. The canister handling areas include a canister transfer station supported by remote handling equipment including a bridge crane (sized to handle large canisters), a DC loading manipulator, and a suite of large/small canister lifting fixtures. A canister storage rack is provided for the accumulation of small canisters. A transfer corridor crane traverses the canister and assembly handling cells for moving equipment in and out of the equipment maintenance bays.

4.4.2.4 Disposal Container Handling System

The DC Handling System prepares empty DCs for loading, receives DCs from the Assembly and Canister Transfer Systems, welds and inspects the DCs, and transfers DCs to the waste emplacement system. The system also transports retrieved waste packages and defective DCs to the Waste Package Remediation System. Refer to Figure 30, MFD-Empty DC Preparation, Figure 31, MFD-Empty DC Transfer, Figure 32, MFD- DC Handling System (Welding and Staging), and Figure 33, MFD- DC Handling System (WP Transfer), in Attachment IV.

Empty DC preparation includes unloading the containers from the rail carrier, staging the containers, installing handling collars and basket spacers, and transferring the empty containers to the DC handling hot cell. DC handling includes transferring empty containers to the Assembly or Canister Transfer System for loading. After loading, the system transfers the containers to DC welding or staging. DC welding operations include positioning the containers on a turntable, removing lid seals, inerting the DC with helium, and installing and welding the inner and outer lids. Each welding operation is followed by nondestructive weld examination and certification. DC transfer operations include tilting the DC to a horizontal position, removing the handling collars, decontamination, and loading the containers into a subsurface transporter.

The DC Handling System is located in the WHB and includes areas for empty DC Preparation; DC Welding; Loaded DC Staging; WP Tilting; WP Decon and Transfer; WP Transporter Loading; and associated operating galleries and equipment maintenance areas. The areas operate concurrently to meet DC handling throughput and support DC handling system maintenance. Refer to WHB figures referenced in Section 4.3.1.2, Waste Handling Building.

The Empty DC Preparation area is located in an unshielded structure. The handling equipment includes a carrier unloading dock, bridge crane, tilting station, DC lid and fixture prep equipment, and a DC transfer cart. The DC hot cell welding area includes eight DC welders, 20 staging positions, five DC transfer carts connecting to assembly and canister transfer systems, and a DC tilting station. Welding operations are supported by a remotely operated bridge crane and hoist, weld station jib cranes, weld station turntables, and robotic welding machines. The WP is loaded in a shielded hot cell supported by a remotely operated horizontal lifting system, decon equipment, remote manipulators, and a horizontal transfer cart. All handling operations are supported by a suite of fixtures including yokes, lift beams, and lid fixtures. Remote equipment is designed to facilitate, maintenance, and interchangeable components are provided where appropriate. Eight remotely operated robotic weld machines are designed to be remotely removed from the welding cell for maintenance, and frequent retooling.

4.4.2.5 Waste Package Remediation System

The Waste Package Remediation System receives retrieved waste packages and defective or off-normal DCs from the DC Handling System and performs operations required for repair or examination. Refer to Cell H-114, Figures 6 through 16 in Attachment IV, Waste Handling/Waste Treatment Building Floor Plans, Sections and Elevations. DCs are sent to the system for minor repair and examination, or major operations requiring opening the container. Waste packages are retrieved for examination if failure or damage to the package has been detected. Nondestructive examination operations include visual, weldment, and physical inspections of a container as well as metallurgical and radiological samples and analysis required for performance confirmation.

A general machining capability provides limited repairs such as welding defects in the package lids. Operations required to open a package will be infrequent, but will utilize the general machining capability to remove the inner and outer lids as required.

System operation is centered around the waste package remediation hot cell (H-114) located in the WHB. The system has direct access to the DC Handling System hot cell, and is designed to handle one container at a time. A waste package or DC arrives at the cell on a transfer cart, and is placed at a repair/examination station by a crane. The package or container will exit the cell by the same method. Before opening, the container will be vented, and the temperature, pressure, and gas composition of the internal package will be sampled. Inner and outer lids will be removed in a way that the package can be refurbished. If possible, if a waste package or DC is beyond repair, a temporary seal will be installed and the DC transferred to the DC Handling System, Assembly Transfer System, or Canister Transfer System for unloading. The open package can be inspected, decontaminated, and transported by the DC Handling System to the Assembly or Canister Transfer System for assembly or canister removal. The empty package can be returned to the Remediation system for further examination or shipped off-site for refurbishment or disposal.

The system includes a wide variety of remotely operated components, including a crane with lifting yokes and fixtures; viewing systems and manipulators; machine tools for opening and/or repairing packages; analyzers and test instruments; and equipment used to take samples, perform nondestructive examinations, and collect data.

4.4.3 Site-generated Radiological Waste Handling

4.4.3.1 Site-generated Radiological Waste Treatment System (RWTS)

The RWTS performs the functions required to receive radioactive low-level waste generated at the waste handling facilities in the RCA, and safely process and package the waste in containers suitable for disposal. The primary system functions include: receive waste, separate waste, process waste, containerize waste, store waste, and plan for off-site disposal. The WTB houses the process systems that segregate liquid and solid LLW streams and package the waste for disposal off-site. Non-recyclable liquid and solid waste streams are grouted, packaged, and shipped off-site for disposal. Recyclable liquid waste is treated via filtration, evaporation, and ion-exchange, and stored in tanks for users in the WHB and WTB. Compactible solid LLW is sorted, segregated, and compacted followed by super-compaction and grouting. Non-compactible solid LLW is also grouted following size reduction. Solid waste is packaged and shipped off-site for disposal. Refer to Figure 34, Recyclable Liquid LLW Treatment, Figure 35, Chemical Liquid LLW Treatment, and Figure 36, Solid LLW Packaging, Attachment IV.

Inherent in the MGR process, low-level radioactive waste is produced in the form of solid and liquid LLW from operations such as cask, facility, and equipment decontamination with wipes and chemicals; pool system skimming and filtration operations; canister/container cuttings; used DPCs; tooling and clothing; facility HVAC filtration, chemical sumps, and carrier/transporter washdowns. These streams are collected by the LLW system, contained, and routed to the WTB where they are sampled and treated by that system.

The system is also designed to receive site-generated LLW by direct pumping of liquid waste in sealed, shielded containers from the site transportation system. The containers are sealed at the facilities where the waste was generated prior to shipment. In the current design, the waste is packaged in 55- or 85-gallon drums; however, consideration will be given to other alternatives (e.g., packaging solid LLW in high integrity boxes, and disposing of DPCs whole or cut up for smelting).

The process vessels, piping, and material handling component designs are shielded for maximum expected radiation and include the required safety barriers, leak detection, and sump collection components to protect operators and the environment from leaks and releases. The process areas are filtered and vented to the WTB ventilation system (see Section 4.3.1.3.2), and the process, ventilation system, and operating areas are continuously monitored by the radiological monitoring and alarm system. LLW processing system components are designed for ease of calibration, replacement, and repair. Radiation protection principles will be incorpoated in the design to achieve ALARA exposure levels. Shielding will be provided in those locations where concentrated wastes are accumulated, such as adjacent to evaporators and ion-exchangers. Provisions for remote repair will also be employed.

4.4.3.1.1 Liquid LLW Subsystem Description

Liquid LLW is received at the Liquid LLW System through shielded piping from the WHB, and from the WTB waste process sumps and vessels. The system performs the waste processing functions required to receive liquid LLW, separate recyclable and non-recyclable liquid waste, process and package waste, treat the recyclable wastewater, and store useable water for users. The system segregates and stores the useable and non-reusable liquid waste in separate tanks. Non-reusable liquid LLW is sent to the Non-Recyclable LLW Subsystem described in the next section. Refer to Figure 34 in Attachment IV, Recyclable Liquid LLW Treatment. The system processes the recyclable liquid waste through evaporation, condensation and ion exchange components. Reusable condensate is stored in a recycle water tank, which includes pumping to facility users.

4.4.3.1.2 Non-Recyclable LLW Subsystem Description

Non-recyclable liquid LLW from the evaporator and aqueous non-recyclable LLW from the WHB are processed and packaged by the Non-Recyclable Liquid LLW Treatment Subsystem. Refer to Figure 35 in Attachment IV, Chemical Liquid LLW Treatment. The chemical pH (hydrogen ion concentration potential) is adjusted, and the waste is immobilized in cement and packaged in drums at a Chemical Drum Fill station.

The non-recyclable liquid waste stream, which consists of those liquid streams which cannot be treated for recycle, is processed on a batch basis into 55-gallon drums for grouting. Portland cement, from an external storage hopper, is delivered and metered into a drum containing liquid low-level waste at a grouting station. A mixer is used to combine the cement and liquid waste to form grout. After curing, the waste drums are transported off-site for disposal.

Recyclable liquid waste (previous section) is processed for reuse via filtration, evaporation, condensation and ion-exchange systems. Liquid waste streams resulting from the processing of recyclable liquid are grouted in the systems discussed above.

4.4.3.1.3 Solid LLW Subsystem Description

Solid LLW is received in a variety of forms, including:

- Resin, slurry, etc. material from the Liquid LLW System

- Compactible material, including rags, clothing, metal shavings, filters, etc.
- Non-compactible material requiring shredding or disassembly, including major pieces of equipment such as opened DPCs and large mechanical parts.

The Solid LLW System receives non-compactible or oversized waste, solid compactible LLW, and spent ion-exchange resins from the liquid LLW treatment subsystem. All three of these waste streams are ultimately encapsulated in cement, after the appropriate processing. The system separates compactible and non-compactible waste, reduces non-compactible waste to compactible form, and compacts the waste for disposal. Large solid waste is routed to a Mechanical Disassembly Station where operators dismantle or cut up and separate the large pieces. The undersize and large pieces are then loaded into separate drums. Refer to Figure 36, Solid LLW Packaging, Attachment IV. The pieces are again separated at a waste type sorting station, where large pieces are routed to a shredder, reducing the waste to compactible form. Shredded and undersized waste are compacted into drums at an in-drum compactor component.

The non-compactible stream from the initial sorting process is placed in 55-gallon drums and routed directly to the grouting station described above. Wet solids, such as spent ion-exchange resin, are grouted directly in 55-gallon drums at a separate grouting station. The grouting stations consist of the equipment necessary to produce a cement stream, which is poured into the appropriate waste drums on a batch basis. The equipment consists of dry Portland cement storage bins, conveyors to feed the dry cement to the WTB, a recycle water feed system, and mixers.

The waste drums are further compacted into high density discs at the super-compacter component. Multiple discs are then packed and stored for off-site disposal. The system also processes ion-exchange resins from the Liquid LLW system and other waste generated in the RWTS process vessels. The waste is collected, dewatered, and grouted in drums at a spent resin drum fill component.

4.4.3.1.4 Mixed Waste

Mixed waste is defined as waste that contains material subject to the Atomic Energy Act (i.e. source, special nuclear, or byproduct material) and that is defined a a hazardous waste subject to regulations promulgated pursuant to the Resource Conservation and Recovery Act (RCRA) (USC 1976). Note that no potential mixed waste streams have been identified. Controls on the use of hazardous materials are expected to be adequate to preclude mixed waste generation. The mixed waste volumes listed in several tables (e.g. Table 6-2, Surface Design Data for Emplacement Operations) are not expected volumes, but rather an allowance for space in the WTB to accommodate a small volume of mixed waste should it ever be needed.

4.4.4 Site Utility Systems

4.4.4.1 Site Electrical Power System

The site electrical power system will provide power and emergency power and distribute and control power to site users, including repository subsurface development and emplacement. The adequacy of the off-site power supply is under investigation. Additional information will be forthcoming. The power system will be upgraded from the existing 69 kV line as described in Section 4.2.2, Pre-Repository Site Conditions. The main substation will distribute power to the North Portal surface and subsurface switchgear and to the South Portal substation. The development shaft area will likely be provided with power from the South Portal substation, and the emplacement shaft area will be provided power from the North Portal switchgear.

The electrical system is managed from the Central Command and Control Operations System, as described in Section 4.4.6.1 of this document, which interfaces with the Supervisory Control and Data Acquisition (SCADA) System that is dedicated to site utility systems monitor and control. Electrical power is distributed throughout the site surface and subsurface, and to remote areas such as the subsurface ventilation shaft openings, construction areas, environmental monitoring stations, transportation lighting and safety systems, and water well sites. Power is provided in sufficient quantity and quality to satisfy worse case user loads. Emergency and uninterruptible power are provided for the durations required to maintain emergency, security, and safety system critical operation. The power is generated by uninterruptible power supplies and diesel generators and switchgear located in various facilities and areas on the surface, as described in Section 4.3.2.8, Standby Generators.

Site power for the construction and operational phases is indicated in Tables 6-1 through 6-5. The percent of total power used by the surface operations is approximated as:

- HVAC 64 %
- BOP/RCA Lighting 16 %
- Process/Weld Equip 18 %
- Other Surface Support 2 %

4.4.4.2 Site Water System

The Site Water System supplies potable and non-potable water to the surface water distribution systems. Site water originates at the NTS wells about 3.5 miles southeast of the North Portal. The water is pumped to a booster station and then to potable and non-potable water tanks on Exile Hill, from where it's distributed throughout the RCA, the BOP area, and to the subsurface. Potable water is provided for drinking, cooling, decontamination, and sanitary uses, and non-potable water is provided for construction and fire protection. The water system meets state of Nevada requirements.

Water appropriations are presently permitted for 430 acre-feet per year. It is estimated that this level of appropriation will adequately meet the water requirements for all future phases of the Yucca Mountain Project (YMP) through Repository Closure.

Present plans for water supply include using Wells J-12, J-13, and C-Well, including a new booster pump station which draws water from Basin 227A at Jackass Flats. This basin has a perennial yield of 4,000 acre-feet, of which 880 acre-feet/year have been committed to DOE (including the 430 acre-feet for the Yucca Mountain Site Characterization Project).

Water chillers, pumps, and compression tanks are provided to supply chilled water to North Portal facility HVAC air handling units. The chilled water equipment is located in the Utility Building. A cooling tower, with associated pumps, and make-up water treatment equipment is provided to supply cooling water for removing heat from the chilled water system and secondary cooling water systems in the WTB. The water treatment equipment is located in the Utility Building. Hot water boilers, pumps, and expansion tanks are provided to supply heating water to the North Portal facility HVAC air handling units.

The water system possesses adequate pumping, flow, pressure, and reserve capacity for the water distribution networks that the system serves. Potable water meets minimum drinking quality standards through treatment.

4.4.4.3 Site Communication System

The Site Communication System maintains site-wide and off-site voice, data and video communications. The system maintains public and secure communications as required for all surface and subsurface communications and for connection to off-site waste transportation operations, emergency response systems, and general communications. The system is located throughout the surface and subsurface portions of the repository and includes the land line and fixed and mobile microwave subsystems required for integrated site/off-site communications. Refer to Figure 37 of Attachment IV. Secure communications are provided for security and safeguards, emergency response, waste transportation, and other protected information systems. The system provides a conservative quantity of data and voice lines, maintains data error checking and correction, and supports data encryption.

The system interfaces with the security, emergency response system, management and administration, maintenance and inventory, safety and environmental monitoring, utilities, facilities, transportation, and waste handling systems. The site communication system has external interfaces with the NTS, satellites, and phone companies.

4.4.4.4 Sanitary Sewer System

The existing sanitary waste system is estimated to be adequate in capacity to handle future phases of repository operations. The system consists of a septic tank and a leach field. Sanitary sewage is collected in the septic tank, and liquid effluent is routed to the leachfield, where it is removed by percolation into the soil. The design standards for the sanitary sewer collection and treatment systems conform to state of Nevada requirements and stipulations.

4.4.5 Safety and Security Systems

4.4.5.1 Security and Safeguards System

The Security and Safeguards System performs the surveillance and safeguards functions required to protect the repository from unauthorized intrusion, sabotage and theft. The system includes the site security barriers, gates, and the automated surveillance, badging, and record subsystems required to monitor and control access to all site areas and facilities.

Security inspections are performed at access points to prevent unauthorized access and theft, and to provide timely detection of contraband, including explosives, arms, and hazardous or dangerous substances. A security patrol capability may be provided to extend the defensive capability of the security system to remote and inaccessible areas of the site to mitigate threats such as armed intrusion. The security office issues badges for specific area access, and maintains continuous monitoring of the site security status, including the security stations, patrols, and security equipment alarms and status. The system maintains accurate personnel and visitor histories, issues valid badges, and investigates and responds to potential threats in a timely manner.

4.4.5.2 Emergency Response System

The Emergency Response (ER) System responds to accident conditions at or near the repository, and returns or stabilizes the conditions to as normal as possible. The system maintains the emergency and rescue equipment, communications, facilities, and trained professionals required to respond to fire, radiological, mining, industrial, and general accident surface and subsurface events.

The system controls evacuation and rescue services and provides medical care to personnel. It coordinates this capability with off-site organizations as required to respond to the accident condition and any injured. The primary emergency response subsystems consist of the fire station, the Medical Center, HP facility, and the mine rescue equipment capability. These subsystems are operated by full time and part time personnel, and are supported by off-site professional medical, fire, radiological, and rescue organizations.

The ER teams are highly trained, and the facilities and systems are maintained at a high degree of readiness to support personnel rescue and treatment of the injured, and to prevent the possibility of further injury, death, or property damage. The system interfaces with all site operational areas and facilities, and maintains a full-time interface with the site communications, transportation, and utility systems.

4.4.5.3 Health Safety System

The Health Safety System monitors personnel exposure to hazardous substances and radiation. The system monitors operational areas for hazardous materials, and personnel for exposure to hazardous substances and operating conditions. The system maintains a robust safety program, performs surveillance and surveys, maintains records, and invokes corrective action for unsafe conditions. The safety system also provides emergency and maintenance breathing air, and controls access to radiologically controlled areas based on personnel radiation exposure histories.

The Health Safety System monitors access to the radiological areas such that the personnel are scanned and verified to be below safe exposure thresholds. Sufficient health safety coverage is provided for all radiological and hazardous areas to ensure that workers are protected from exposure to hazards, and that the safety measures, safety clothing, and equipment decontamination facilities are adequate. Monitoring, recording, and tracking of personnel health safety records supports the operational needs of all repository operations where hazardous materials and radiation are involved.

The Health Safety System supports all hazardous operations, and interfaces with the Administration System for the identification, training, and tracking of site personnel data. The primary HP laboratories, offices, and calibration shops are located in the WHB and WTB operations area. Protective equipment and clothing are also stored in those areas. The system interfaces with the Central Command & Control Operations System for controlling personnel work loads and assignments based on exposure limits and quarterly accumulations.

4.4.5.4 Surface Environmental Monitoring System

The Surface Environmental Monitoring System monitors the surface areas and ground waters for radioactive and hazardous substance release into the environment. The system monitors and collects environmental data from key site areas for airborne particles containing radioactive or hazardous components. It also monitors facility effluents, test wells for radiation and hazardous particles, trends and records the data, and alerts the appropriate alarm stations when established thresholds are exceeded.

The system includes sensors, instrumentation, and analyzers, and the manual and automated data collection equipment required to collect, process, display, store, and archive site environmental data and provide periodic reports.

4.4.6 Management and Administration Systems

4.4.6.1 Central Command and Control System

The Central Command and Control System performs the function of providing supervisory level monitoring of the status of repository operations and support systems. The system includes the automated data processing equipment and network communications equipment required to automatically acquire critical status data from all site facility, utility, and subsurface monitoring and control subsystems. The subsystem provides real time display, independent alarm, trending and storage of primary site, facility, utility, and system status data. Independent supervisory control is provided for critical functions of the Site Utility Systems, and subsurface control systems implemented with remote control capability. The system provides for operating messages and advisories to facility monitoring stations via the site communications system.

The system maintains monitoring of the primary functions associated with critical site safety and utility systems. Status information and site operating parameters are recorded and trended in a way that supports improved operating methods.

The Material Control and Accountability (MC&A) program will be in accordance with 10 CFR 73.45, Physical Protection of Plants and Materials. Accurate, current, and reliable information will be acquired on the quantities, descriptions, and locations of Spent Fuel Assemblies (SFA), including the shipping casks and containers containing SFAs. MC&A procedures and supporting systems will be utilized at the repository facilities to accurately determine, periodically confirm, and record the quantity of nuclear material handled at the repository, including the nuclear material received, stored, emplaced, shipped, or otherwise removed from inventory. Alarms and alerts will be generated when inventory items are missing for any reason. The central control system will acquire and maintain the MC&A records, and the administration system will issue the accountability reports required by Federal regulations.

4.4.6.2 Maintenance and Supply System

The Maintenance and Supply System procures, stores, and distributes equipment, parts, materials and consumables required to ensure that site operations are able to operate with a minimum of downtime, and to support repair, maintenance, and improvement activities. The primary repair shops, warehouses, and equipment yards are located on the surface.

This system maintains automated maintenance tracking and inventory management programs, and interfaces with the site procurement system to anticipate the appropriate quantity of supplies required for planned and unplanned maintenance operations. The inventory and procurement management systems are located in the Administration Building in the BOP area. The system warehouses equipment and materials utilizing stacking and retrieving equipment, and interfaces with site transportation to distribute the materials to users. Except for construction material and equipment, the supply system is maintained in the Central Warehouse, also in the BOP area.

4.4.6.3 Administration System

The Administration System performs the site management and administration services required to plan and direct repository operations, including Waste Handling, Emplacement, Development, Transportation Dispatch operations, and subcontract management.

It is located in the Administration Building in the BOP area. The Management and Control segment performs the repository management and planning functions. The system utilizes automated data processing equipment to generate the integrated operational plans, optimize operations, and minimize operational costs. The system tracks repository performance, determines variances, updates the operational plans, and reports on progress. The Administration Services segment performs the function required for purchasing, document control, training, payroll, human resources, and food services. The system is required to issue purchase orders as needed to maintain equipment inventories and consumables, maintain accurate employee and project documentation records, and provide the employee services needed for salary administration, career growth, and other conveniences.

The Administration System interfaces with the Site Communications System, and shares planning, progress and needs data and reports with collateral management, maintenance, inventory, transportation, and fabrication systems at the site and related off-site facilities.

4.4.7 Transportation Systems

4.4.7.1 General Site Transportation System

The General Site Transportation System provides road, rail, and transportation safety and support systems required to transport personnel and materials between the various facilities and areas of the repository surface. The system includes the repository vehicles, parking, and motor depots necessary to maintain the transportation of essential personnel and materials. The general transportation routes connect the site with non-waste related off-site transportation, the BOP area, the South Portal area, the RCA, and the shaft areas. Access roads are also provided for security access areas and utility equipment and facility areas.

4.4.8 Non-Radiological Waste Systems

4.4.8.1 Site-Generated Hazardous and Nonhazardous Waste Disposal System

The Site-Generated Hazardous and Nonhazardous Waste Disposal System collects and handles the hazardous and sanitary wastes generated at the site. Site-generated radioactive wastes are handled by the Site-Generated Radiological Waste Handling System (Section 4.4.3).

The system collects and packages solid and liquid hazardous waste at the points of generation throughout the surface and subsurface. The packaged waste is transferred to accumulation sheds to wait for off-site shipment. Sanitary, nonhazardous waste is collected at containers and dumpsters throughout the site, and is periodically collected and transferred to off-site disposal. Sanitary liquid waste is routed via sewer lines to the sanitary waste treatment facility on the surface. Subsurface wastewater is pumped to the wastewater collection system on the surface.

The Site-Generated Hazardous and Nonhazardous Waste Disposal System is not yet developed. The system will minimize the generation of mixed wastes and protect the environment and personnel from exposure to hazardous waste during collection, packaging and storage. This system will collect, store, transport and dispose of site-generated wastes in accordance with Nevada statutes and Federal orders for hazardous waste packaging and transportation and environmental protection standards.

The Site-generated Hazardous and Nonhazardous Waste Disposal System interfaces with all waste site operations and facilities, supported by surface and subsurface material transportation systems for the movement, collection, and shipment of waste.

5. DESCRIPTION OF EVALUATION CASE DESIGNS

This section describes the designs for the alternative evaluation cases by describing the changes from the reference design and providing a tabular summary of key facility and system parameters. Eleven evaluation cases were selected for developing engineering data for the EIS contractor. The selection objectives were to minimize the number of cases while ensuring that the NOI alternatives and options that have the greatest impact on the surface facilities are represented. The NOI alternatives and options are described in Section 3. The reference case is described in Section 4.

Three cases (S1-B, S2-B, and S3-B) accommodate the baseline repository inventory of 70,000 MTHM, which includes CSNF, vitrified HLW and DOE SNF. The emplacement phase for these cases and the reference design (S0-B) is scheduled to span 24 years.

The remaining eight cases represent two variations on the reference case and three other baseline inventory cases described above. These variations address the alternative inventory Modules 1 and 2, which are described in Table 3-1. Module 1 cases are S0-1, S1-1, S2-1, and S3-1, and the Module 2 cases are S0-2, S1-2, S2-2, and S3-2. The emplacement phase for these eight cases is scheduled to span 38 years. The designs of the constructed facilities for these cases are the same as for the corresponding baseline inventory designs (i.e., S0-B, S1-B, S2-B, and S3-B) because the peak annual receipt rates are similar. As a result, the designs of all eleven evaluation cases can be described by providing descriptions of four design configurations.

Each of these design configurations is described below, and a tabular summary of key facility and system parameters for these configurations is provided in Table 5-1. In the reference design configuration (S0-B, 1 and 2), 88 percent of the waste is received in large rail casks, with the balance received in LWT casks. All of the LWT casks and 43 percent of the CSNF rail casks contain uncanistered CSNF assemblies. The balance of the CSNF rail casks contain DPCs. All of the HLW and DOE SNF are received in DISPCs by rail.

Table 5-1. Key Facility and System Parameters

Case Numbers Design Case Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered/ DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Carrier/Cask Shipping and Receiving Systems				
Peak Annual Carrier Receipt Rates				
Rail Carriers (Waste, empty DCs, and DPC overpacks)	1,497	None	1,180	1,507
Truck Carriers (Waste)	124	3,540	193	192
All Types	1,621	3,540	1,373	1,699
Site Carrier Parking Capacity				
Rail	91	None	70	92
Truck	27	192	24	24
CPB Prep stations	4	12	4	4
CPB gross floor space (square feet)	20,040	49,500	20,040	20,040
Waste Preparation Systems				
Peak Annual Carrier Receipt Rate (Waste, DPC overpacks)	989	2,939	559	956
Carrier Bay Bridge Cranes	1 @ 125 tons	2 @ 40 tons	1 @ 125 tons	1 @ 125 tons
Assembly Transfer System				
Peak annual rates				
Casks	551	2,344	143	563
DPCs	411	None	None	419
Assemblies	12,250	12,493	725	12,211
DCs	381	421	25	400
Cask preparations stations per line	1	2	1	1
No. lines (cask preparation and unloading)	3	4	1	3
No. lines (assembly drying and DC load)	3	3	1	3
Canister Transfer System				
Peak annual rates				
Casks	187	670	609	188
DISPCs	801	670	934	595
DCs	157	205	621	205
Cask preparation stations per line	1	2	1	1

Table 5-1. Key Facility and System Parameters, continued

Case Numbers **Design Case Name** **Waste Inventories** **Predominant Transportation Mode** **CSNF Cask Configuration**	**S0-B, 1 & 2** **Reference Design** **All** **Rail** **Uncanistered/ DPC**	**S1-B, 1 & 2** **All LWT** **All** **LWT** **Uncanistered**	**S2-B, 1 & 2** **Mostly DISPC** **All** **Rail** **DISPC**	**S3-B, 1 & 2** **Mostly DPC** **All** **Rail** **DPC**
No. lines	2	3	3	2
DC Handling System				
Peak annual DC rates	524	601	631	580
No. of weld stations	8	8	8	8
DC staging capacity	20	20	20	20
WHB net floor space[1] (square feet)	462,000	583,319	399,963	462,000
Site-generated Radioactive Waste Handling System				
Generated LLW Rates (pre-treatment)				
Recyclable Liquid (gal per year)	228,500	327,500	174,600	240,500
Non-recyclable Liquid (gal per year)	68,700	95,300	55,700	71,100
Solid (cubic feet per year)	46,500	110,300	40,800	46,100
WTB gross floor space (square feet)	77,900	103,700	68,300	77,900
Sanitary Sewer Influent (million gal/year)	7.6	9.8	7.4	7.6
Utility Systems				
Peak Utility Rates				
Well water (gal per minute)	460	545	460	460
Electric Power (MW)	11.0	13.9	10.4	11.0
Utility Building gross floor space (square feet)	22,000	23,600	21,600	22,000
Safety and Security Systems				
Peak portal traffic				
Waste receipt portal (vehicles per day)	15	28	15	15
BOP/RCA portal (personnel per day)	573	880	573	573
RCA perimeter (feet)	15,500	10,500	15,500	15,500
Gross floor space (square feet)				
Fire Station	7,600	7,600	7,600	7,600
Medical Center	8,200	8,900	8,150	8,200
Management & Administration Systems				
Gross floor space (square feet)				
Administration Building	44,000	50,100	43,600	44,000
Central Warehouse	57,000	71,600	56,000	57,000
Central Shops	57,000	64,0000	57,000	57,000

Table 5-1. Key Facility and System Parameters, continued

Case Numbers Design Case Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered/ DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Staff and Facility				
Repository staff (full-time equivalents(FTEs)) – includes South Portal)	1,510	1,806	1,491	1,511
Approx. total gross floor areas (square feet)				
North Portal facilities				
Within RCA	588,600	739,400	526,600	588,600
BOP	235,440	263,840	233,990	235,440
Total	824,040	1,003,240	760,590	824,040
Non-Radioactive Waste Systems (annual)				
Solid Waste				
Hazardous (cubic feet)	3,600	9,100	3,800	3,500
Sanitary/Industrial (cubic yards)	1,440	1,870	1,410	1,440
Recyclable (cubic yards)	3,600	4,690	3,520	3,600
Liquid Waste				
Hazardous (gallons)	700	1,700	700	700
Sewage (million gallons)	7.6	9.8	7.4	7.6

Source: CRWMS M&O 1999a, pp. 2 and 3.

[1] Floor areas are net (i.e., usable). The value for the reference design differs from that reported in the VA (462,000 gross, 440,000 net) (DOE 1998b, Volume 2, Section 4.1.4.2, p. 4-9).

5.1 ALL LEGAL WEIGHT TRUCK CASE (S1-B, 1 AND 2)

In this case, all of the waste is received in LWT casks. CSNF casks contain 4 PWR or 9 BWR assemblies (e.g., GA4/9) and the HLW and DOE SNF casks contain one DISPC. None of the casks contain DPCs.

The number of transportation casks increased from the reference design by a factor of four. This change increased the size and quantity of the SSCs associated with staging and handling of transportation casks. These increases included the capacity of site carrier parking, the number of CPB preparation stations, the number of bridge cranes in the WHB carrier bay, the number of assembly transfer lines (cask preparation and cask unloading areas only), the number of canister transfer lines, and the number of cask preparation stations provided in each waste transfer line.

The increase to the waste receiving and packaging operations also resulted in higher site-generated waste quantities and therefore increased the size of the WTB. The size of the support facilities and site systems also increased slightly due to the increases in the waste receipt, waste packaging and site-generated waste treatment operations.

The All LWT case also eliminates the need for the extensive rail yard shown in Figure 4, Attachment IV. As a result, the CPB can be located much closer to the RCA and flanked on either side by adequate but more extensive LWT carrier parking. The SSCs provided to receive, load, and handle DCs were not impacted by this case.

5.2 MOSTLY DISPOSABLE CANISTERS CASE (S2-B, 1 AND 2)

In this case, 83 percent of the waste is received in large rail casks, with the balance received in LWT casks. The LWT casks contain uncanistered CSNF and all of the CSNF rail casks contain DISPCs. All of the HLW and DOE SNF is received in DISPCs by rail.

The total number of transportation casks is similar to the reference design; therefore, the design of the waste receipt operations and WHB carrier bay are unchanged. Unlike the reference case, all of the rail casks contain DISPCs, which must be unloaded in canister transfer lines rather than assembly transfer lines. This change reduces the cask rate to the assembly transfer system by 70 percent, reducing the number of assembly transfer lines to one. This change also increases the cask rate to the canister transfer system by a factor of three, requiring the addition of one canister transfer line.

These changes to the waste packaging operations resulted in lower site-generated waste quantities and therefore decreased the size of the WTB. The size of the support facilities and site systems also decreased slightly due to the reduction in waste packaging and site-generated waste treatment operations.

5.3 MOSTLY DUAL-PURPOSE CANISTERS CASE (S3-B, 1 AND 2)

In this case, 83 percent of the waste is received in large rail casks with the balance received in LWT casks. The LWT casks contain uncanistered CSNF and all of the CSNF rail casks contain DPCs. All of the HLW and DOE SNF is received in DISPCs by rail.

The peak rates of casks, assemblies, DPCs, DISPCs, and DCs to the various waste receipt and packaging operations are similar to the reference design. As a result, the design of the surface facilities will also be the same as in the reference design.

Note: the quantities of site-generated waste produced over the life of the facility will be higher than in the reference design due to the increased use of DPCs.

6. ENVIRONMENTAL DATA

This section includes tabular summary level engineering values (i.e., staffing, wastes, vehicle trips, resources, and land use) for the reference design and the evaluation design cases that address construction, emplacement operations, caretaker operations, and closure. Environmental data for the retrieval case are provided in Attachment I.

As described in Section 5, the eleven design evaluation cases can be represented by four basic facility configurations. Therefore, most of the environmental data for the four configurations are also the correct data for the eleven design evaluation cases. An exception is the cumulative post-treatment secondary waste generation quantities, because these quantities are impacted by the total waste disposal quantity and the duration of the emplacement period. These data are provided for each case in Section 6.2.

The duration of each phase and the year the phase starts is summarized in Figure 6-1 for all cases. In general the durations are the same, except for the emplacement period, which is 14 years longer for the cases with the larger waste disposal quantities (i.e., Module 1 and 2 inventories.

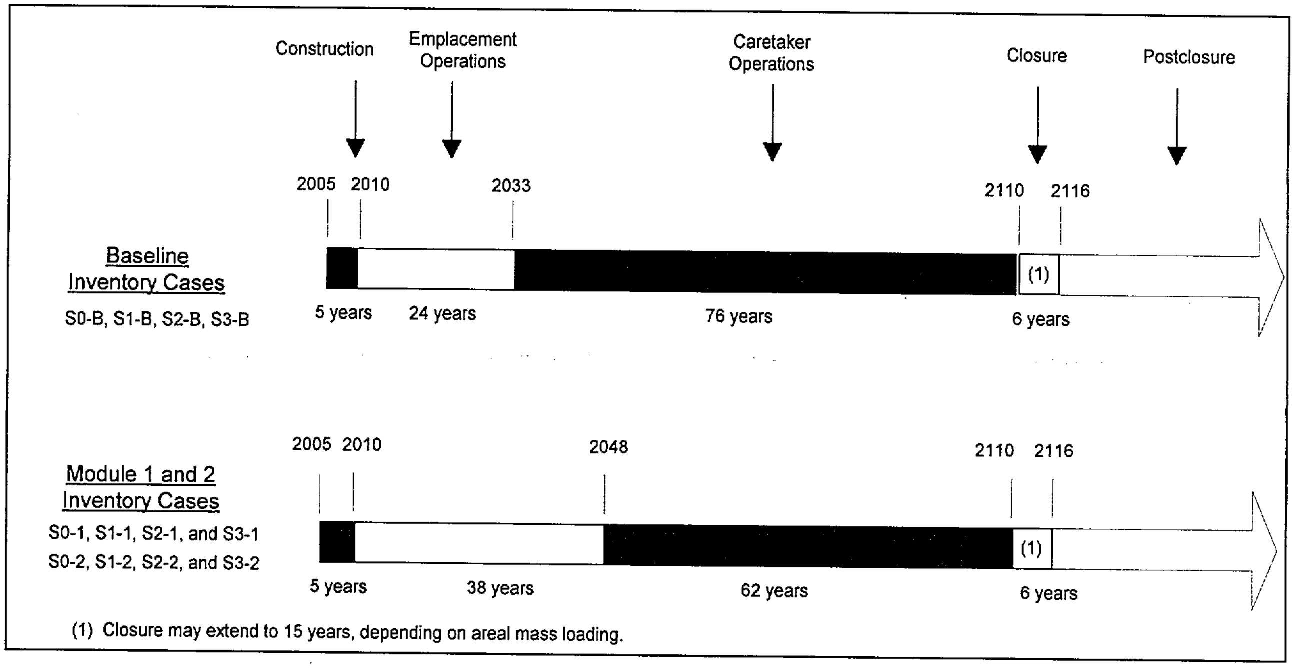

Figure 6-1. Repository Schedule (Start Year and Duration)

6.1 CONSTRUCTION

The repository surface facility Construction Phase is expected to span about five years, beginning in March 2005. Construction activities occur over 44 months and include site preparation, construction of nuclear and support facilities, and the initial verification testing of components and systems. The staffing, utility and resource usage, emissions, and site-generated waste will peak toward the middle of construction. Following construction, the operations staff will be hired and trained and cold start-up will be completed.

Table 6-1 contains the engineering quantities of interest to the EIS contractor for this phase. The data listed below are provided for the reference design configuration and the three evaluation case design configurations. In general the configurations requiring more extensive facilities will have the greatest impact on the environment. The Reference Design (S0) and the Mostly DPC configuration (S3) are similar, the All LWT configuration (S1) has a larger impact, and the Mostly DISPC configuration (S2) has a lesser impact. These data do not include the impacts from start-up.

A. Employment - work years (FTEs) expended during the Construction Phase, broken down by craft workers, construction management and staff, and peak annual employment.

B. Resources - materials consumed during the Construction Phase, including utilities, concrete, steel and liquid fuels, and utility consumption rate during a peak construction hour.

C. Wastes - total solid and liquid wastes generated during the Construction Phase, including concrete, steel, industrial trash, sanitary wastewater, oils, and lubricants. The steel waste materials will be recycled as scrap material before completing construction. No radioactive or mixed wastes are generated during construction.

D. Emissions - Air pollutants emitted during the phase, including fugitive dust (from land clearing, site preparation, excavation, and other construction activities), exhaust from on-site vehicles during grading and construction activities, and exhaust from vehicles and buses delivering construction materials and workers.

The amount of land to be graded during this phase is indicated in the Land Use area of the table. It is expected that the EIS contractor will estimate the construction emissions based on the construction staffing and the graded land area.

E. Land Use - site area disturbed during the phase, including the area cleared for repository construction, laydown area for material and equipment storage, limited on-site fabrication for support of construction, and controlled receiving and staging for construction materials. This area is in addition to the area previously disturbed by ESF construction and operations.

F. Storm drainage originating from surface facilities will be collected to a single point of discharge. It is possible that in the future storm water may be required to be discharged to an evaporation pond.

Table 6-1. Surface Design Data for Construction

Case Numbers Design Configuration Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered/ DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Employment (Total for construction phase of 3 years 8 months)				
Total for Phase (FTEs)				
Craft Workers	1,773	2,377	1,654	1,756
Construction Management & Staff	675	905	629	668
Total	2,448	3,282	2,283	2,424
Peak Annual (craft workers only)	644	864	601	638
Materials/Resources (Total for the Construction Phase unless noted)				
Utilities				
Electricity (MWh)	8,638	10,868	8,207	8,575
Well Water (1000 gallons)	46,200	49,280	45,936	46,156
Liquid Fuels (gallons)	632,000	847,300	589,500	625,800
Utilities (peak rate)				
Electricity (MW)	2.05	2.57	1.94	2.03
Well Water (gallons per day)	61,000	66,000	61,000	61,000
Solids				
Concrete (cubic yards)	145,177	182,008	126,307	144,322
Gravel(cubic yards)	8,745	42,628	7,455	8,745
Asphalt (cubic yards)	1,128	1,128	1,128	1,128
Steel (tons)	34,130	40,677	29,646	32,304
Industrial Gases (1000 scf)	1,816.1	2,434.7	1,693.8	1,798.2
Wastes Generated (Total for the Construction Phase)				
Solids				
Concrete, Gravel, and Asphalt (cubic yards)	3,100	4,520	2,700	3,080
Steel (tons)	512	610	445	485
Sanitary/Industrial (cubic yards)	4,896	6,564	4,565	4,847
Recyclable (cubic yards)	12,240	16,409	11,413	12,118
Hazardous (drums)	3,546	4,754	3,307	3,511
Liquid				
Sanitary Wastewater (million gals)	3.88	5.23	3.64	3.84
Oils and Lubricants (gallons)	12,640	16,946	11,790	12,516
Total Trucks and Buses to/from Site	33,279	46,410	29,826	32,960
Land Use (acres)				
Construction Support Area (acres)	97	101	97	97

scf = standard cubic feet

Source: CRWMS M&O 1999a, p. 4.

6.2 EMPLACEMENT OPERATIONS

Repository emplacement operations will begin in March 2010 and are expected to span about 24 years for the baseline inventory cases and 38 years for the Module 1 and 2 inventory cases. Surface emplacement operations include waste receiving, waste preparation (i.e., repackaging the waste into DCs), site-generated LLW treatment, and support operations (e.g., maintenance, administration, security, utility supply, warehousing). After the initial ramp up, emplacement operations are generally steady over the entire emplacement period. Operations are planned for three shifts per day, with the greatest number of total personnel on-site during the day shift, decreasing to the lowest number during the third shift, which consists mostly of maintenance and support, with some waste handling operations. Site-generated effluents, sanitary and hazardous waste, and LLW will be at a maximum during this phase.

Tables 6-2 and 6-3 contain the engineering quantities of interest to the EIS contractor for this phase. In general, environmental impacts during emplacement are minimized by reducing the number of cask receipts, maximizing the use of DISPCs, and minimizing the use of DPCs (as opposed to uncanistered fuel casks).

The following data are provided in Table 6-2:

A. Employment - total employment (in FTEs) for primary areas of the North Portal, including: WHB, CPB, WTB, RCA site workers, administration, maintenance and supply, medical and fire, security, and other surface operating services.

B. Worker Radiation Dose - employment breakdown by worker dose category (400, 100, 25 and 0 mrem per year), average total annual individual dose, and total cumulative annual dose to surface facility workers. The workers that perform operations on loaded casks and those performing hot cell and pool maintenance are expected to receive the highest doses (average 400 mrem per yr). Workers in hot cell galleries and those conducting secondary waste treatment operations should receive medium average dose levels (100 mrem/yr). Other workers within the RCA should receive a minimal dose (25 mrem per yr), and workers outside the RCA are expected to receive a negligible radiation dose.

C. Utilities - electricity, well water, and liquid fuels consumed during a peak emplacement year. Annual consumption and consumption rate during a peak hour are provided.

D. Chemicals - annual consumption of chemicals related primarily to preparation and treatment of water streams. Although only those chemicals consumed in significant quantities are listed, other chemicals will be utilized throughout the facility.

E. Wastes - total post treatment solid and liquid wastes generated annually. Included are solid LLW, recyclable waste, solid and liquid mixed waste, hazardous waste, sewage, and contaminated empty DPCs. LLW is packaged for disposal and shipped off-site for disposal. Untreated mixed and hazardous wastes are packaged for shipping and sent off-site for treatment, recycle, and disposal. Sanitary/industrial wastes are sent to an off-site landfill; however, the option to use an on-site sanitary landfill near the North Portal area is being kept open. Recyclable solid wastes are segregated at the point of generation and shipped to off-site commercial recyclers. Wastewater is treated as described in Section 4. Rainwater runoff from the BOP is discharged directly to the natural drainage channels. The data for DPCs are based on disposal in a dismantled form (i.e., cut-up). This dismantlement operation would be conducted off-site. Alternatively, the DPCs may be disposed whole, or smelted for metal recovery.

F. Emissions - average annual air pollutants emitted during the phase including various gases used or generated as a result of the activities conducted in the surface facilities. Effluent streams are thoroughly scrubbed and/or filtered to remove or reduce the amount of undesirable particulates before they are released to the vent streams. Radioactive gas emissions result from spent fuel assembly cladding leaks assumed to occur in a small fraction of the fuel assemblies. Chemical emissions are primarily generated by the diesel boiler that provides steam or hot water for HVAC heating.

G. Land Use - site area cleared to construct the repository surface facilities. This area is shown on Figure 3 of Attachment IV. Table 4-2 lists the area occupied by each building and non-building support facility. This table lists existing buildings and facilities that are used to support the repository, and those BOP facilities that must be provided as new facilities. The numbers presented reflect the high thermal area-loading option for repository emplacement.

Table 6-2. Surface Design Data for Emplacement Operations

Case Numbers Design Configuration Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered/ DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Employment (FTEs)				
WHB	376	513	363	376
CPB	22	75	22	22
WTB	40	53	39	40
TMB and RCA Site	54	88	54	54
Administration	245	279	243	245
Security	44	44	44	44
Maintenance and Supply	117	137	113	117
Medical/Fire	42	42	42	42
Other Services	41	46	42	42
Total	981	1,277	962	982

Table 6-2. Surface Design Data for Emplacement Operations, continued

Case Numbers Design Configuration Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered/ DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Worker Dose (annual)				
Employment by Dose Category (FTEs)				
Cask Operations & Maintenance @400 mrem/yr	199	464	199	199
Pool/Cell Ops. @ 100 mrem/yr	244	297	228	244
Other RCA workers @ 25 mrem/yr	149	175	150	149
Other Workers @ 0 mrem/yr	389	341	386	390
Total Workers	981	1,277	962	982
Average Annual Dose (mrem/yr)	110	172	110	110
Cumulative Annual Dose (rem/yr)	108	220	106	108
Utilities (Peak)				
Annual				
Electricity (MWh)	69,700	87,400	67,400	69,700
Well Water (million gallons)	41.1	50.9	41.1	41.1
Liquid Fuels (gallons)	2,022,000	2,458,000	1,989,000	2,022,000
Peak utility rates				
Electricity (MW)	11.0	13.9	10.4	11.0
Well Water (gallons per minute)	460	545	460	460
Liquid Fuels (gallons per hour)	615	739	615	615
Chemicals (annual)				
Solid Chemicals				
Dry CO_2 (lb)	26,000	26,000	24,100	26,700
Solidification Agent (cubic feet)	27,700	58,100	22,000	27,700
Resin (ion-exchange) (cubic feet)	2,400	9,000	140	2,300
NaCl (1000 pounds)	300.6	300	300	300.6
$Al_2(SO_4)_3$ (pounds)	8,900	8,800	8,800	8,900
Liquid Chemicals (gallons)				
Cleaning Solvents (gallons)	131	334	126	129
Sodium Hydroxide (gallons)	61	240	60	57
Oils & Lubricants (gallons)	500	1,277	482	492
H_2SO_4 (1000 pounds)	34.5	35.6	34.4	34.5
Gaseous Chemical (pounds)				
Chlorine (pounds)	1,300	1,280	1,280	1,300
Helium (pounds)	132,900	151,500	133,900	146,100
Nitrogen (pounds)	65,700,000	183,000,000	16,800,000	87,052,000
Wastes Generated (annual, post treatment)				
Solid Waste				
Low-Level Radioactive (cubic feet)	46,500	110,300	40,800	46,100
Mixed Waste (cubic feet)	9.9	25.5	10.6	9.8

Table 6-2. Surface Design Data for Emplacement Operations, continued

Case Numbers **Design Configuration Name** **Waste Inventories** **Predominant Transportation Mode** **CSNF Cask Configuration**	**S0-B, 1 & 2** **Reference Design** **All Rail** **Uncanistered/ DPC**	**S1-B, 1 & 2** **All LWT** **All LWT** **Uncanistered**	**S2-B, 1 & 2** **Mostly DISPC** **All Rail** **DISPC**	**S3-B, 1 & 2** **Mostly DPC** **All Rail** **DPC**
Hazardous (cubic feet)	3,600	9,100	3,800	3,500
Sanitary/Industrial (cubic yards)	1,440	1,870	1,410	1,440
Recyclable (cubic yards)	3,600	4,690	3,520	3,600
Dismantled Empty DPCs (number)	411	0	0	419
Liquid Waste				
Hazardous (gallons)	700	1,700	700	700
Mixed (gallons)	29	74	31	29
Sewage (million gallons)	7.6	9.8	7.4	7.6
Aequous Wastewater to Evaporator Pond (million gallons / year)	6.7	8.0	6.7	6.7
Gaseous Emissions (annual)(1)				
Radioactive (curies) (annual average)				
Krypton 85	2570	2560	93	2590
Krypton 81	$1.03\ 10^{-6}$	$1.03\ 10^{-6}$	3.7 10-8	1.04 10-6
Xenon 127	Neg.	Neg.	Neg.	Neg.
Radon 219	$3.34\ 10^{-5}$	$3.32\ 10^{-5}$	$1.19\ 10^{-6}$	$3.36\ 10^{-5}$
Radon 220	$1.41\ 10^{-2}$	$1.41\ 10^{-2}$	$3.45\ 10^{-4}$	$1.43\ 10^{-2}$
Radon 222	$4.61\ 10^{-6}$	$4.59\ 10^{-6}$	$1.65\ 10^{-7}$	$4.64\ 10^{-6}$
PM_{10} (tons)	To be provided	To be provided	To be provided	To be provided
Chemical				
Sulfur Dioxide (tons)	17.9	21.8	17.7	17.9
Oxides of Nitrogen (tons)	52.5	63.6	52.4	52.5
VOC (tons)	0.5	0.6	0.5	0.5
Carbon Monoxide (tons)	13.2	16.0	13.2	13.2
TSP (tons)	5.1	6.2	5.1	5.1
Land Use (Disturbed area in acres)				
Prior to Repository Construction	372	372	372	372
North Portal Surface Facilities and Roads	154	158	154	154
South Portal, Shaft Areas, Muck Storage	389	389	389	389
On-site Sanitary Landfill Option if selected	9	9	9	9
Total Disturbed Area	924	928	924	924

scf = Standard cubic feet
VOC = Volatile Organic Compounds
TSP = Total Suspended Particulates
PM_{10} = particulate matter: 10 microns and smaller
Source: CRWMS M&O 1999a, pp. 5 and 6.
(1) Refer to Table 6-3. Post Treatment Waste Generation Quantities for the Entire Emplacement Operations Phase

Table 6-3. presents the cumulative site-generated waste for the four cases, three inventories, and two periods of emplacement duration.

Table 6-3. Post Treatment Waste Generation Quantities for the Entire Emplacement Operations Phase

Case Number Waste Inventory Emplacement Duration	S0 – B Baseline 24 years	S1 - B Baseline 24 years	S2 - B Baseline 24 years	S3 – B Baseline 24 years
Solid Waste				
Low-Level Radioactive (cubic feet)	901,200	2,372,000	642,200	916,700
Mixed Waste (cubic feet)	208	561	222	211
Hazardous (cubic feet)	74,200	200,500	79,400	75,300
Liquid Waste				
Hazardous (gallons)	13,800	37,300	14,700	14,000
Mixed (gallons)	604	1,633	647	614

Case Number Waste Inventory Emplacement Duration	S0 – 1 Module 1 38 years	S1 - 1 Module 1 38 years	S2 - 1 Module 1 38 years	S3 – 1 Module 1 38 years
Solid Waste				
Low-Level Radioactive (cubic feet)	1,448,100	4,041,900	1,314,400	1,466,900
Mixed Waste (cubic feet)	340	940	370	340
Hazardous (cubic feet)	121,000	336,300	131,900	121,000
Liquid Waste				
Hazardous (gallons)	22,500	62,500	24,500	22,500
Mixed (gallons)	985	2,740	1,075	985

Case Number Waste Inventory Emplacement Duration	S0 - 2 Module 2 38 years	S1 - 2 Module 2 38 years	S2 - 2 Module 2 38 years	S3 – 2 Module 2 38 years
Solid Waste				
Low-Level Radioactive (cubic feet)	1,593,200	4,649,300	1,459,600	1,612,000
Mixed Waste (cubic feet)	410	1,160	440	410
Hazardous (cubic feet)	147,100	414,700	158,100	147.100
Liquid Waste				
Hazardous (gallons)	27,300	77,000	29,400	27,300
Mixed (gallons)	1,200	3,380	1,290	1,200

Source: CRWMS M&O 1999a, p. 7.

6.3 CARETAKER OPERATIONS

Repository caretaker operations begin after the last DC is emplaced in the repository and end when the NRC authorizes closure activities. The Caretaker Phase maintains the capability to retrieve the emplaced waste, required for 100 years following the beginning of emplacement. The phase is expected to span about 76 years for the baseline inventory cases, beginning in 2033 and ending in 2110. The phase is expected to span about 62 years for the Module 1 and 2 inventory cases, beginning in 2047 and ending in 2110. Initial caretaker operations are expected to span about three years and include the decontamination of surface nuclear facilities, the lock-down of facilities, and the shutdown and preservation of electrical, mechanical, and hydraulic systems. In general, the cases requiring more extensive facilities will have the greatest impact on the environment during the decontamination and shutdown operations. The Standby phase of the Caretaker Operations Phase will support a minor security force, Performance Confirmation, and maintenance operations involving a minimal number of facilities and utilities.

Tables 6-4 and 6-5 contain the engineering values of interest to the EIS contractor for this phase.

Table 6-4 provides the data listed below for the initial decontamination and facility shutdown period.

A. Employment - work years (FTEs) expended during facility decontamination and lock down, including workers, management, and staff.

B. Resources - materials consumed during the facility decontamination, including utilities, fuels, and solid and liquid chemicals.

C. Wastes - total solid, liquid hazardous, and LLW processed during the decontamination of facilities, including industrial trash and sanitary waste.

Table 6-5 provides the data listed below for the Standby period of the Caretaker Operations Phase. The impacts during this period are not expected to vary from case to case.

A. Employment - annual employment required for the remainder of the phase, including security and maintenance required for minimal site operations, possibly including Performance Confirmation operations.

B. Utilities - Annual and peak utilities usage during the Standby period.

C. Wastes - volume of annual industrial solid and sewage waste generated during standby, including industrial trash and sanitary wastewater.

Table 6-4. Surface Design Data for Caretaker Decontamination Operations

Case Numbers Design Configuration Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered /DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Employment (Total for initial decontamination)				
Total work years (FTEs)	2,575	3,352	2,525	2,578
Materials/Resources (Total for initial decontamination)				
Utilities				
Electricity (MWh)	200,000	250,000	193,000	200,000
Well Water (1000 gallons)	156,000	193,700	156,000	156,000
Liquid Fuels (gallons)	7,077,000	8,603,000	6,961,000	7,077,000
Solid Chemicals				
Solidification Agent (cubic feet)	7950	10,380	7,120	8,010
Resin (ion-exchanged) (cubic feet)	106	134	93	106
NaCl (1000 pounds)	154	191	154	154
$Al_2(SO_4)_3$ (pounds)	8,250	8,160	8,160	8,250
Liquid Chemicals (gallons)				
Cleaning Solvents	131	334	126	129
Sodium Hydroxide	168	660	165	157
Oils & Lubricants	1,250	3,190	1,200	1,230
H_2SO_4 (1000 pounds)	32	33	32	32
Gaseous Chemicals (pounds)				
Chlorine	1,625	1,600	1,600	1,625
Wastes Generated (Total for the initial decontamination and shutdown operations, post treatment)				
Solid Waste				
Low-Level Radioactive (cubic feet)	14,500	18,400	12,800	14,500
Mixed Waste (cubic feet)	9.9	25.5	10.6	9.8
Hazardous (cubic feet)	3,600	9,100	3,800	3,500
Sanitary/Industrial (cubic yards)	4,435	5,955	4,340	4,500
Recyclable (cubic yards)	11,090	14,935	10,840	11,210
Liquid Waste				
Hazardous (gallons)	700	1,700	700	700
Mixed (gallons)	28.9	74.1	30.7	28.6
Sewage (million gallons)	23	31	23	23

MWh= megawatt hour FTE = full-time equivalent
Source: CRWMS M&O 1999a, p. 8.

Table 6-5. Surface Design Data for Caretaker Shutdown Operations

Case Numbers Design Configuration Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered /DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Employment (Annual FTEs)				
Total	35	35	35	35
Utilities				
Annual Electricity (MWh) Well Water (1000 gallons) Liquid Fuels (gallons)	minimal	minimal	minimal	Minimal
Wastes Generated (annual)				
Sanitary/Industrial Solids(cubic yards)	7	7	7	7
Sewage Liquids (1000 gallons)	54	54	54	54

MWh = megawatt hour FTE = full-time equivalent
Source: CRWMS M&O 1999a, p. 9.

6.4 CLOSURE

The repository Closure Phase begins after the Caretaker Operations Phase, when authorized by the NRC. The phase is expected to span about 6 years, beginning in 2111 and ending in 2116. Surface closure operations include final decontamination and demolition of the nuclear facilities (e.g., scalping concrete and removing steel liners and contaminated equipment), dismantlement and removal of the surface structures, grading and landscaping to return to a more natural look (if required), and construction of monuments (e.g., pyramids).

Table 6-6 contains the engineering values of interest to the EIS contractor for this phase. The data listed below are provided for the reference design and the three evaluation cases associated with the baseline inventory (i.e., 70,000 MTHM). In general, the cases requiring more extensive facilities will have the greatest impact on the environment during final decontamination and demolition. The Reference Design (S0) and the Mostly DPC configuration (S3) are similar, the All LWT configuration (S1) has a larger impact, and the Mostly DISPC configuration (S2) has a lesser impact.

A. Employment - work years (FTEs) expended during demolition and site restoration, broken down by craft workers, construction management and staff, and peak annual. The number of surface FTEs is dependent on surface activities and is minimally affected by the time of closure, which might vary with areal thermal loading of the repository.

B. Resources - materials consumed during demolition and site restoration, including utilities, chemicals and gases, concrete and steel, and liquid fuels.

C. Wastes - total solid and liquid, hazardous, nonhazardous, and LLW wastes generated during the entire phase, including industrial trash and sanitary wastewater. The steel waste materials will be recycled as scrap material, and minimal mixed wastes are expected to be generated.

D. Emissions - Air pollutants emitted during the phase, including fugitive dust (from land clearing, site preparation, excavation, and other closure activities), exhaust from on-site vehicles during grading and closure activities, and exhaust from vehicles and buses delivering or removing materials and workers.

The amount of land to be graded during this phase is expected to be that indicated in the Land Use area of Table 6-1. It is expected that the EIS contractor will estimate the closure emissions based on the closure staffing and the graded land area.

Table 6-6. Surface Design Data for Closure

Case Numbers Design Configuration Name Waste Inventories Predominant Transportation Mode CSNF Cask Configuration	S0-B, 1 & 2 Reference Design All Rail Uncanistered /DPC	S1-B, 1 & 2 All LWT All LWT Uncanistered	S2-B, 1 & 2 Mostly DISPC All Rail DISPC	S3-B, 1 & 2 Mostly DPC All Rail DPC
Employment (Total for the entire phase)				
Total for Phase				
Craft Workers	1,208	1,576	1,113	1,195
Construction Management & Staff	460	599	424	455
Total	1,668	2,175	1,537	1,650
Peak Annual	401	523	370	396
Materials/Resources (Total for the entire phase unless noted)				
Utilities				
Electricity (MWh)	8,467	10,009	8,087	8,419
Well Water (1000 gallons)	71,352	74,808	71,136	71,352
Liquid Fuels (gallons)	413,400	539,200	380,900	408,800
Utilities (peak hour)				
Electricity (MW)	1.23	1.45	1.17	1.22
Well Water (gallons per day)	65,000	69,000	65,000	65,000
Industrial Gases (1000 scf)	1,188	1,549	1,094	1,175
Wastes Generated (Total for the entire phase, post treatment)				
Solids				
Low-Level Radioactive (cubic feet)	90,000	122,000	73,000	90,000
Concrete (cubic yards)	152,435	191,108	132,622	151,538
Steel (tons)	34,130	40,677	29,646	32,304
Other Sanitary/Industrial (cubic yards)	3,336	4,350	3,074	3,300
Recyclable (cubic yards)	8,340	10,875	7,685	8,250
Hazardous (drums)	2,319	3,025	2,137	2,294
Liquid Waste				
Sanitary Wastewater (million gallons)	2.53	3.30	2.33	2.53
Oils and Lubricants (gallons)	8,268	10,784	7,618	8,176
Total Trucks and Buses to/from Site	29,707	41,223	26,343	29,422

MWh = megawatt hour
MW = megawatt
FTE = full-time equivalent
scf = standard cubic feet
Source: CRWMS M&O 1999a, p. 10.

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ACRONYMS AND ABBREVIATIONS

AB	Airlock Building
ACD	Advanced Conceptual Design
ADP	automated data processing
ALARA	as low as reasonably achievable
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
Assys	assembly
ATS	Assembly Transfer System
BLM	Bureau of Land Management
BOP	Balance of Plant Area
BWR	boiling-water reactor
CCHS	Carrier/Cask Handling System
CDA	Controlled Design Assumptions Document
c_i	curies
CISF	Centralized Interim Storage Facility
cm	centimeter
cm^2	square centimeters
CMF	Cask Maintenance Facility
CPB	Carrier Preparation Building
CRWMS	Civilian Radioactive Waste Management System
CSNF	commercial spent nuclear fuel
CSU	concrete storage unit
CWB	Carrier Washdown Building
DC	disposal container
DCS	Design Concept Surface
DISPC	disposable canister
DOE	(U.S.) Department of Energy
DOPAA	Description of Proposed Action and Alternatives
DOT	U.S. Department of Transportation
DPC	dual-purpose canister
DSNF	DOE spent nuclear fuel (DOE SNF)
EBS	Engineered Barrier System
EIS	Environmental Impact Statement
ER	emergency response
ESF	Exploratory Studies Facility
FSF	fuel storage facility
ft	foot/feet
FTE	full-time equivalent
FY	fiscal year

gal	gallon
GTCC	Greater than Class C
GWd	gigawatt/day
HEPA	high-efficiency particulate air
HLW	high-level waste
HP	health physics
hr	hour
HVAC	Heating, Ventilating, and Air Conditioning
IAEA	International Atomic Energy Agency
kV	kilovolt
KW	kilowatt
LA	license application
LAD	License Application Design
lb	pound
LLW	low-level (radioactive) waste
LWT	legal-weight truck
m	meter
M&O	Management and Operating Contractor
MC&A	Material Control and Accountability
MFD	Mechanical Flow Diagram
MGDS	Mined Geological Disposal System (now Monitored Geologic Repository)
MGR	Monitored Geologic Repository (formerly Mined Geological Disposal System)
MOX	mixed oxide
MPC	multi-purpose canister
mrem	millirem
MRS	monitored retrievable storage
MTHM	metric tons heavy metal
MVA	megavolt-ampere
MW	megawatt
MWh	megawatt hour
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
NWPA	Nuclear Waste Policy Act
OCRWM	Office of Civilian Radioactive Waste Management
OPM	off-site prime mover
pH	hydrogen ion concentration potential
PM_{10}	particulate matter: 10 microns and smaller
PMF	probable maximum flood

PWR	pressurized water reactor
QA	Quality Assurance
QAP	Quality Administrative Procedure
QARD	Quality Assurance Requirements and Description
RCA	Radiologically Controlled Area
RCRA	Resource Conservation and Recovery Act
RDRD	Repository Design Requirements Document
RIB	Reference Information Base
RSA	Regional Service Agent
RSC	Regional Service Contractor
RWTS	Radiological Waste Treatment System
SCADA	Supervisory Control and Data Acquisition
scf	standard cubic feet
SCP-CD	Site Characterization Plan Conceptual Design
SFA	spent fuel assembly
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SPAR	Special Performance Assessment Required
SPM	site prime mover
sq	square
sq ft	square feet
SSCs	Structures, Systems, and Components
TMB	Transporter Maintenance Building
TSC	transportable storage cask
TSLCC	Total System Life Cycle Cost
TSP	total suspended particulates
TSRD	Transportation System Requirements Document
TYP	typical
UBC	Uniform Building Code
UCF	uncanistered fuel assemblies
UPS	uninterruptible power supply
USC	United States Congress
VA	Viability Assessment
VOC	volatile organic compounds
WHB	Waste Handling Building
WP	waste package
WSF	Waste Staging Facility
WTB	Waste Treatment Building
YMP	Yucca Mountain Project

Attachment I

Surface Facilities Data for the Waste Retrieval Case

CONTENTS

Page

FIGURES

TABLES

Page

1. PURPOSE AND SCOPE

The purpose of this attachment is to describe the design concept, operations, and surface facilities required to provide safe retrieval and storage of 70,000 MTHM of high-level waste from the Monitored Geologic Repository (MGR). For the purposes of this attachment, waste retrieval is defined as removal of all the waste packages placed in the subsurface repository during emplacement operations (see Section 6.2 of main report). Retrieval can take place any time after the start of emplacement, and the design approach will comply with the principles of ALARA (as low as reasonably achievable). For this section, retrieval operations are assumed to occur at the end of the caretaker period (see Section 6.3 of main report).

During retrieval, it is assumed that waste packages are removed from the emplacement drifts, hauled to the surface, and transferred to a Waste Retrieval Storage Facility. This facility stores the retrieved waste in a manner that protects the health and safety of the public and workers, and maintains the quality of the environment. The Waste Retrieval Storage Facility design consists of a Waste Retrieval Transfer Building, support facilities, and a number of reinforced concrete storage pads located near the repository North Portal. The facility is equipped for waste package unloading, transfer to a vertical Concrete Storage Unit (CSU), and transport of each CSU to a dry concrete storage pad location. The design, construction, operation, and environmental data associated with the Waste Retrieval Storage Facility are provided in Section 6 of this attachment.

2. ASSUMPTIONS

2.1 Waste retrieval rates are limited by the subsurface operations to 4 waste packages per day.

2.2 Retrieved waste packages are intact and handled in a manner compatible with emplacement (i.e., no damage, corrosion, or breach in containment is assumed)

- The on-site Waste Retrieval Storage Facility will be located 12,200 feet from the repository North Portal by rail.

2.3 The rail system built for waste emplacement will be upgraded and new construction will be provided for waste retrieval and transport from the North Portal to the Waste Retrieval Storage Facility.

2.4 The amount of waste retrieved is 70,000 MTHM, the same as the amount emplaced for the baseline inventory. Retrieval of Module 1 or 2 inventories will require proportionately longer retrieval time and larger storage areas.

- The maximum size and weight of the waste package is per the *Preliminary List of Waste Package Designs for VA* (CRWMS M&O 1998g, pg. 3).

- The maximum size and weight of the CSU is 104 inches in diameter, 240 inches long, and 25 tons..

- The concrete storage pad area will be sited at the location shown in Figure I-1.

2.6 The equipment used for subsurface waste retrieval and transport will be the same as that used for emplacement. The equipment and operations used to unload waste packages delivered from the subsurface repository will be the same as those described in Section 4.4.2.4 of the main document, Disposal Container Handling System.

2.7 The design of a CSU will be similar to that used for a commercial MPC design with modifications to account for reduced shielding and 100-year-old waste.

2.8 CSU shielding will reduce the external gamma dose rate at contact to 10 mrem per hr. The concrete shield thickness is equivalent to 22 inches at the beginning of emplacement and 8 inches after an additional 100 years of radioactive decay. The 5-inch waste package corrosion allowance and corrosion resistance shells are equivalent to 16 inches of concrete shielding.

The CSU will be remotely loaded and transported for storage using a hydraulic-powered mobile lifting gantry.

2.9 The Waste Retrieval Storage Facility will employ advanced material handling technology.

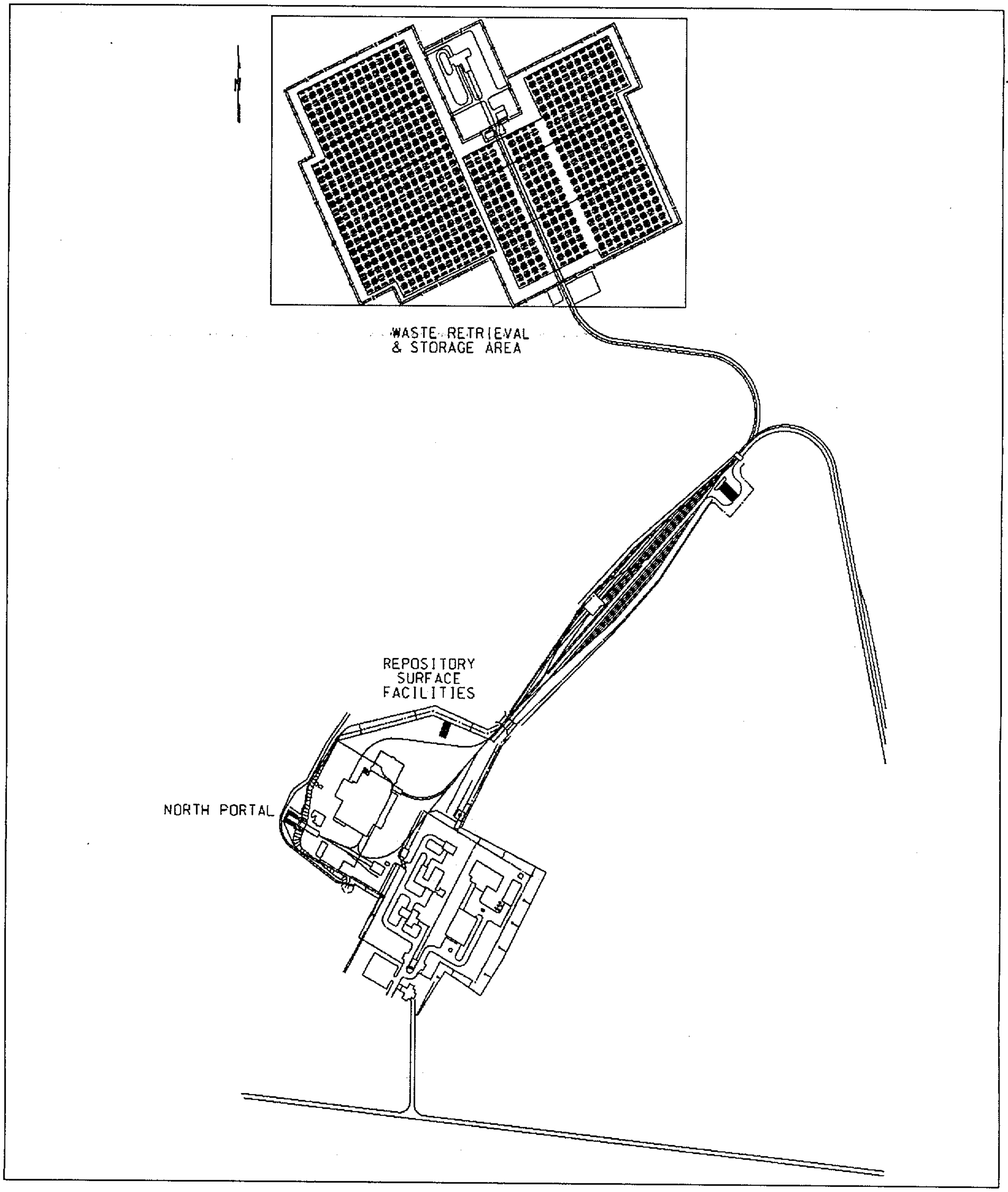


Figure I-1. Analyzed Site – Waste Retrieval Storage Facility

3. SITE LOCATION AND DESCRIPTION

The site selection criteria for the Waste Retrieval Storage Facility are:

- Proximity to the repository North Portal
- Retrieval of all repository waste in the shortest possible timeframe
- Adequate site space for dry storage of 70,000 MTHM of waste
- Ground displacements due to earthquakes
- Minimize engineering needed to protect against the probable maximum flood
- Minimum costs for construction of the facility
- Minimum effects to the environment

The analyzed site for the Waste Retrieval Storage Facility is in the Midway Valley near the repository North Portal as shown in Figure I-1. The area selected contains approximately 240 acres, which is adequate to accommodate the 70,000 MTHM required for the facility. The area slopes from northwest to southeast at an existing grade of 3 to 4 percent. Site grading will be required to prepare the site for the Waste Retrieval Storage Facility (see Section 5.4).

The site studies that required construction of the retrieval facility are described in Attachment III. The environmental properties of the repository North Portal area have been extensively studied.

4. CONCEPT OF OPERATIONS

A brief description of waste retrieval operations is provided in this section. Waste packages are removed from the emplacement drifts in the reverse manner in which they were placed. A waste package is loaded into a rail transporter and hauled to the surface by electric locomotives similar to those used for emplacement operations. Using a surface transport prime mover, the waste package transporter is hauled to the Waste Retrieval Storage Facility, where it enters the Waste Retrieval Transfer Building.

The transporter is docked to a shielded room and the waste package is remotely unloaded from its reusable railcar and tilted to the vertical position using an 80-ton overhead crane. A CSU base is staged and placed in position for direct transfer of the waste package to the CSU. Once the waste package is loaded into the CSU base, the CSU annular shield, a shielded lid, and a protective cover are remotely installed. A 110-ton capacity mobile lifting gantry is remotely moved to the CSU, engages the CSU lifting bails, and picks-up the loaded CSU for transport to a concrete storage pad.

The remotely operated mobile gantry exits the Waste Retrieval Transfer Building and transports the CSU to its designated storage location. The operation is repeated 1,020 times per year over a period of 10 years for 10,200 waste packages. This rate is higher than the repository emplacement rate in the CDA (CRWMS M&O 1998b, Table 3-9, p. 3-14.) because the surface facilities are not required to assemble the waste package, only retrieve it. This annual retrieval rate is equivalent to 20 waste packages per week, or 4 per day, using 255 workdays per year. The waste retrieval and transfer operations are expected to employ a staff of 20 persons.

5. FACILITIES AND SYSTEMS

5.1 WASTE STORAGE PAD LAYOUT AND DESCRIPTION

Figure I-2 shows a layout of the proposed waste retrieval storage area. The total amount of waste stored is 70,000 MTHM or 10,200 waste packages. The waste retrieval storage area is configured for seven time-phased modules each capable of storing 10,000 MTHM or 1460 waste packages. Each module consists of 104 storage pads designed for 14 to16 waste packages storing 96 to 110 MTHM of waste. Each modular reinforced concrete storage pad provides space for transport and storage of 14 vertical CSUs as shown in Figure I-3. The modular concrete storage pad is 80 feet square and approximately 3 feet thick using the *Centralized Interim Storage Facility Topical Safety Analysis Report* (CRWMS M&O 1997d, Volume I, Book 2, Chapter 7, Figure 7.6-1). Seven CSU positions are provided on both sides of a 23-foot transport aisle used for moving the CSU into position.

The CSU design and construction is shown conceptually in Figure I-4. The CSU consists of an annular vertical cylinder and base with a maximum outside diameter of 104 inches and maximum height of 240 inches. The inside diameter provides a gap between the CSU and the waste package for natural circulation cooling of the waste package. Based on preliminary shielding calculations using the methodology developed in the *Preliminary Dose Assessment for the MGDS Surface Facility Waste Handling Operations* (CRWMS M&O 1995a, Section 9.1.2), the CSU includes eight inches of concrete for radiation protection to reduce gamma doses to approximately 10 mrem per hr at surface contact. The maximum CSU weight is 25 tons. When the CSU is assembled and loaded with a waste package, a shielded lid and cover are installed. The total weight is less than 110 tons. Figure I-5 shows the operations in a mechanical flow diagram style..

Table I-1 provides a summary of the design characteristics for the CSU and the concrete storage pads described above.

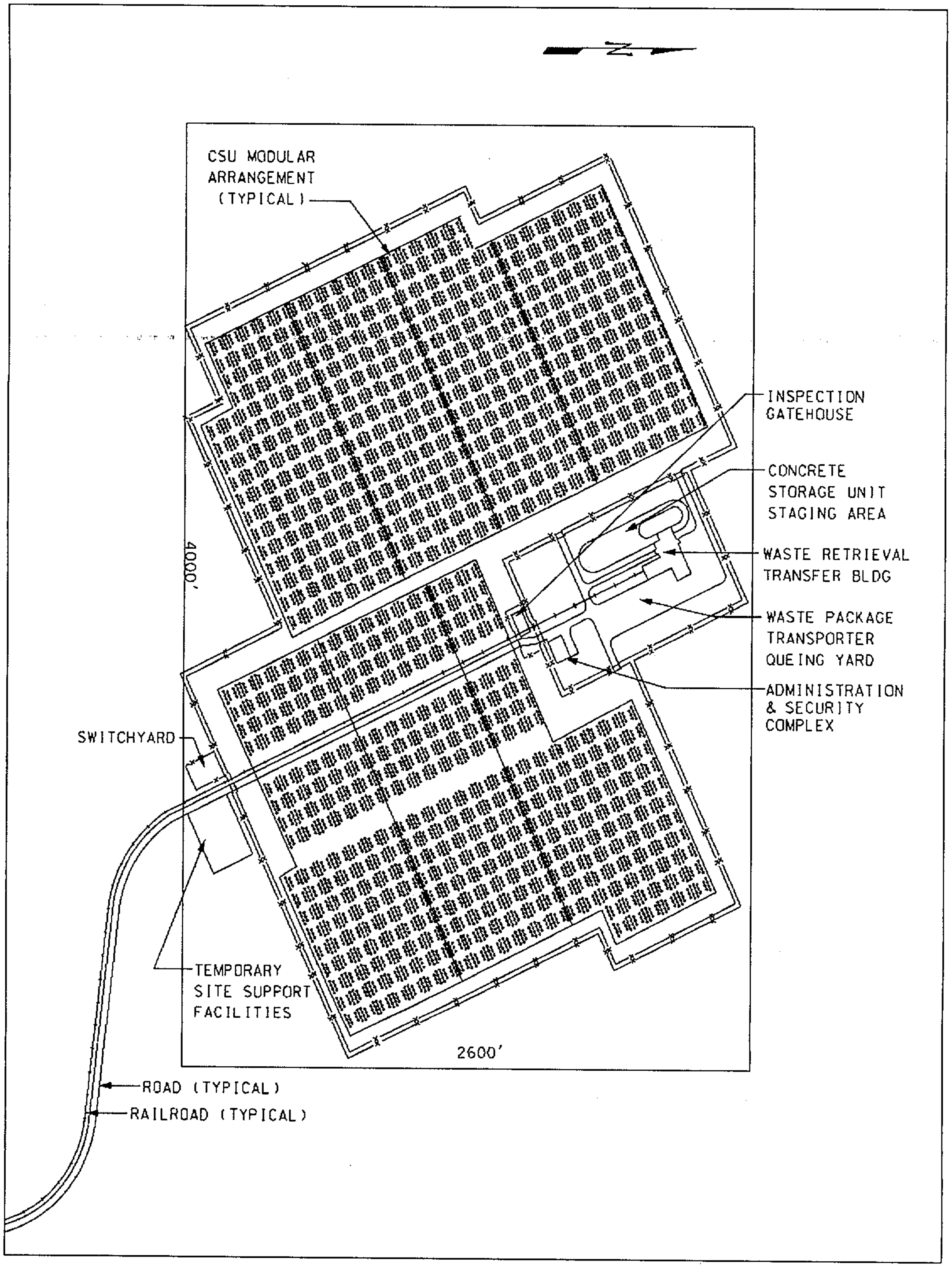


Figure I-2. Waste Retrieval Storage Area Layout

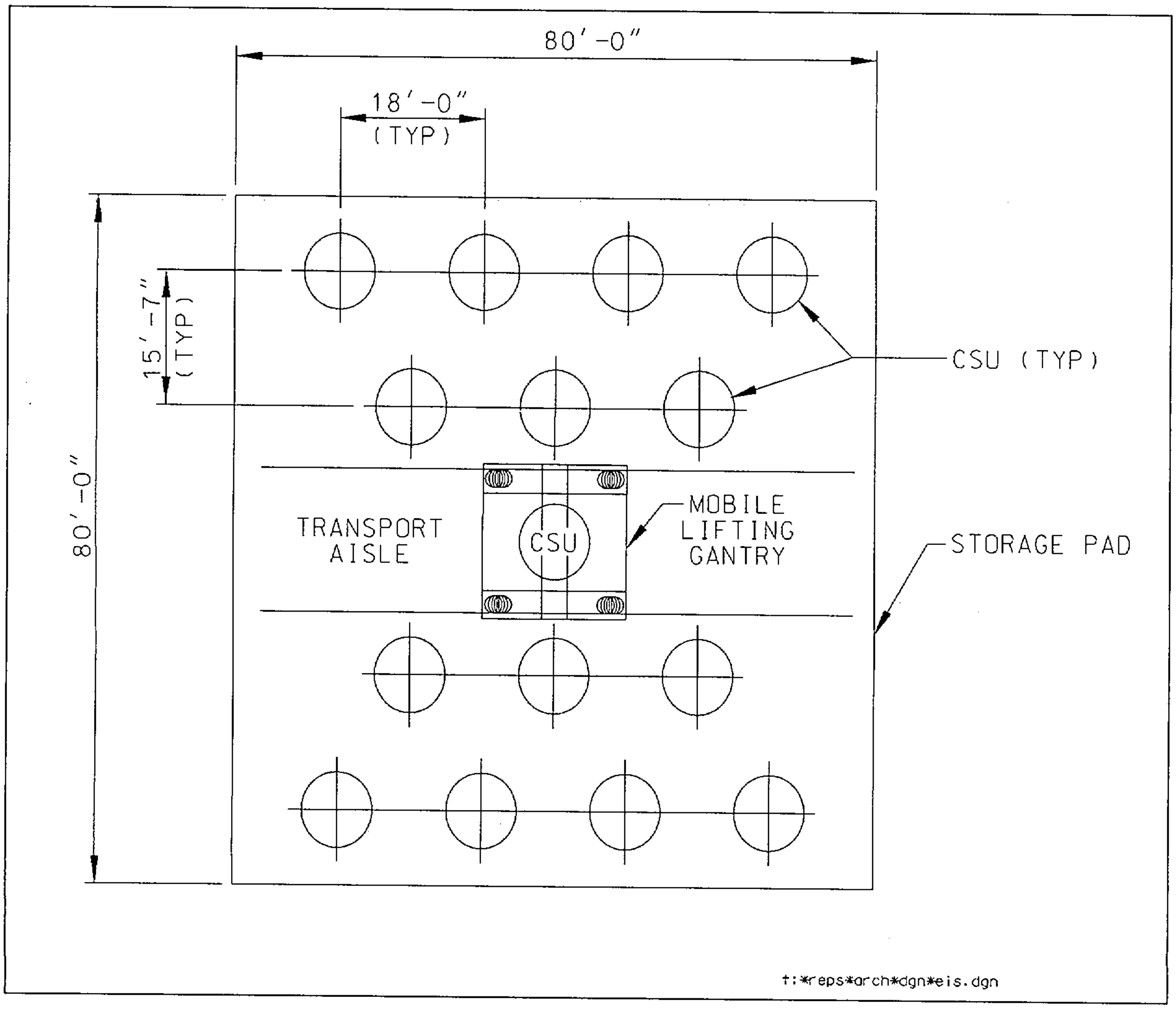


Figure I-3. Modular Concrete Storage Pad

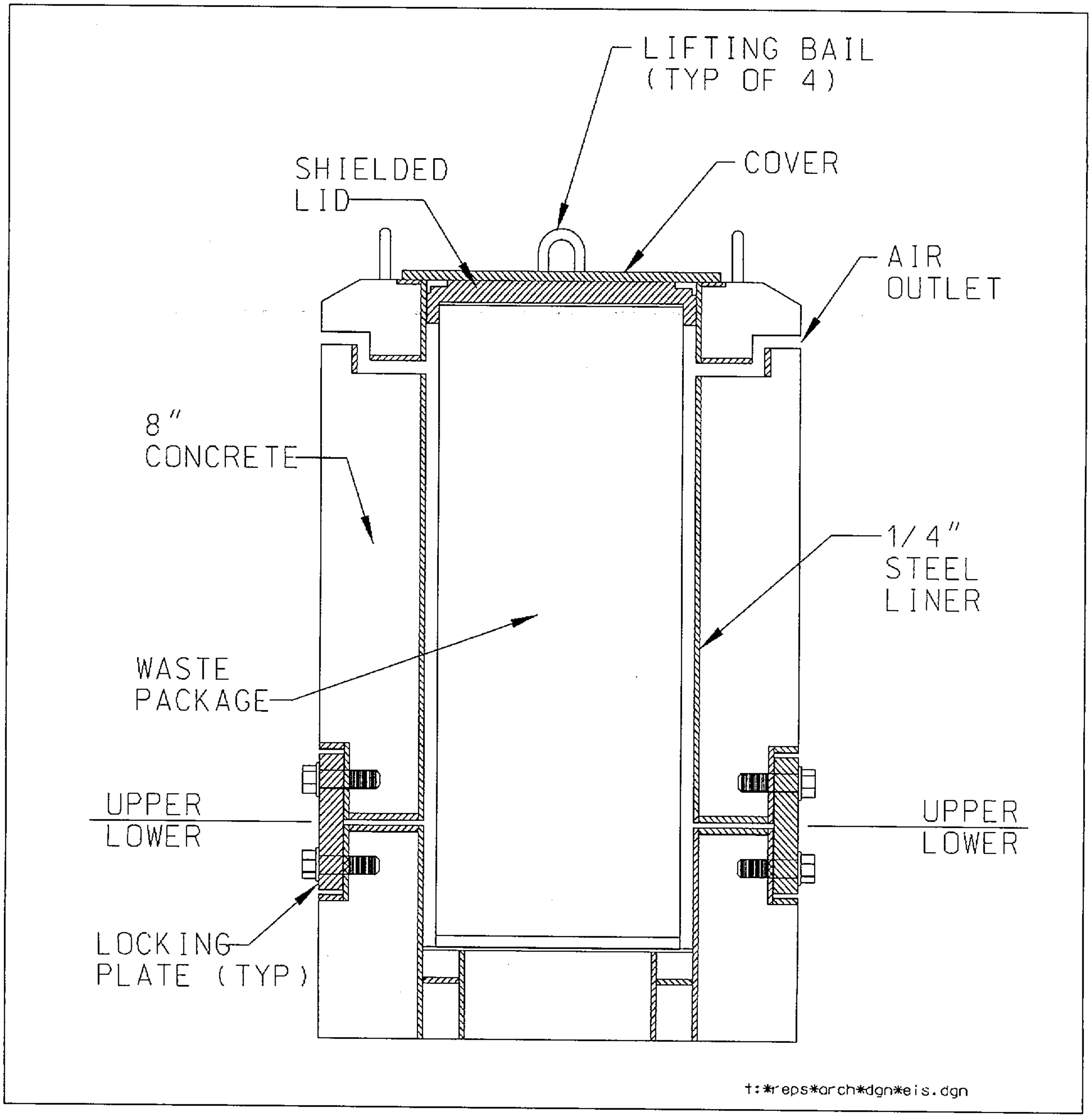


Figure I-4. CSU Design and Construction Concept

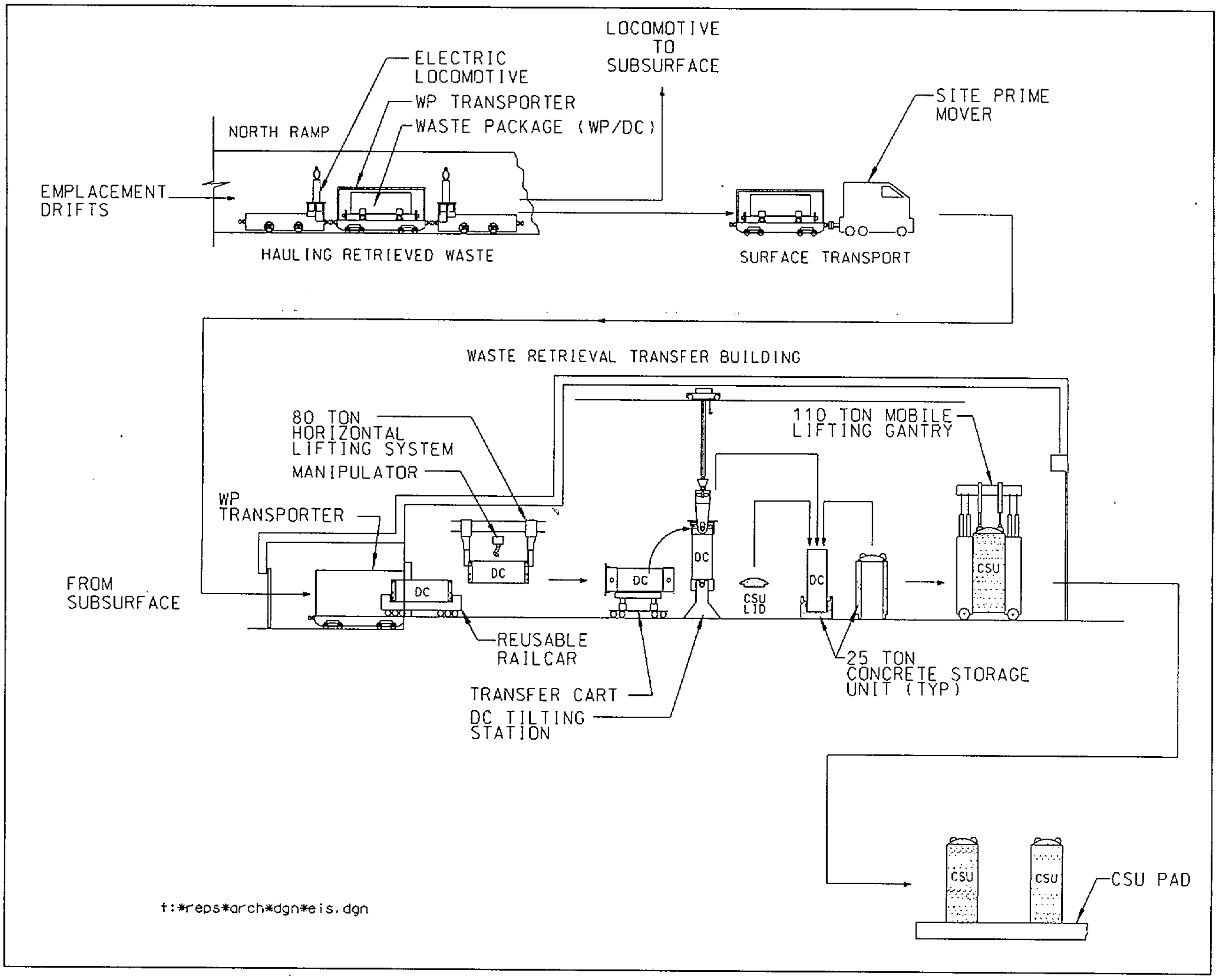


Figure I-5. Operations Mechanical Flow

Table I-1. Design Characteristics of the CSU and the Concrete Storage Pads

Design Parameter	Value
CSU Maximum Diameter	8.7 feet
CSU Maximum Height	20 feet
CSU Maximum Tare Weight	25 tons
CSU Maximum Loaded Weight	110 tons
CSU Maximum Surface Dose Rate	10 mrem per hr
CSU Maximum Wall Thicknesses	8 inches
Modular Storage Pad Dimensions	80 ft x 80 ft x 3 ft
Storage Pad Area	6400 sq ft / 0.15 acre
Number of CSUs per Storage Pad	14
Minimum CSU Spacing on Storage Pad	18 ft
Waste Stored on Storage Pad	96 MTHM
Number of CSUs for 10,000 MTHM of Waste	1460
Number of Storage Pads for 10,000 MTHM of Waste	104
Storage Pad Area for 10,000 MTHM of Waste	15 acres
Number of CSUs for 70,000 MTHM of Waste	10,200
Number of Storage Pads for 70,000 MTHM of Waste	730
Storage Pad Area for 70,000 MTHM of Waste	107 acres

Source: CRWMS M&O 1999, p. 11

5.2 WASTE RETRIEVAL STORAGE FACILITY

Figure I-6 shows the conceptual design of the Waste Retrieval Storage Facility. The facility is located near the waste storage pad area shown in Figure I-2. The site contains space for a Waste Retrieval Transfer Building, a waste package transporter rail queuing yard, a CSU staging area, a switchyard, an off-normal holding area, an inspection and receipt gatehouse, and an administrative and security complex.

The Waste Retrieval Storage Facility site is 600 feet by 1000 feet in size and occupies 14 acres of land. The Waste Retrieval Storage Facility site is furnished with both rail and road access. The existing rail system to the repository North Portal area will be upgraded to provide for waste package transport from the subsurface directly to the Waste Retrieval Storage Facility. The rail access route

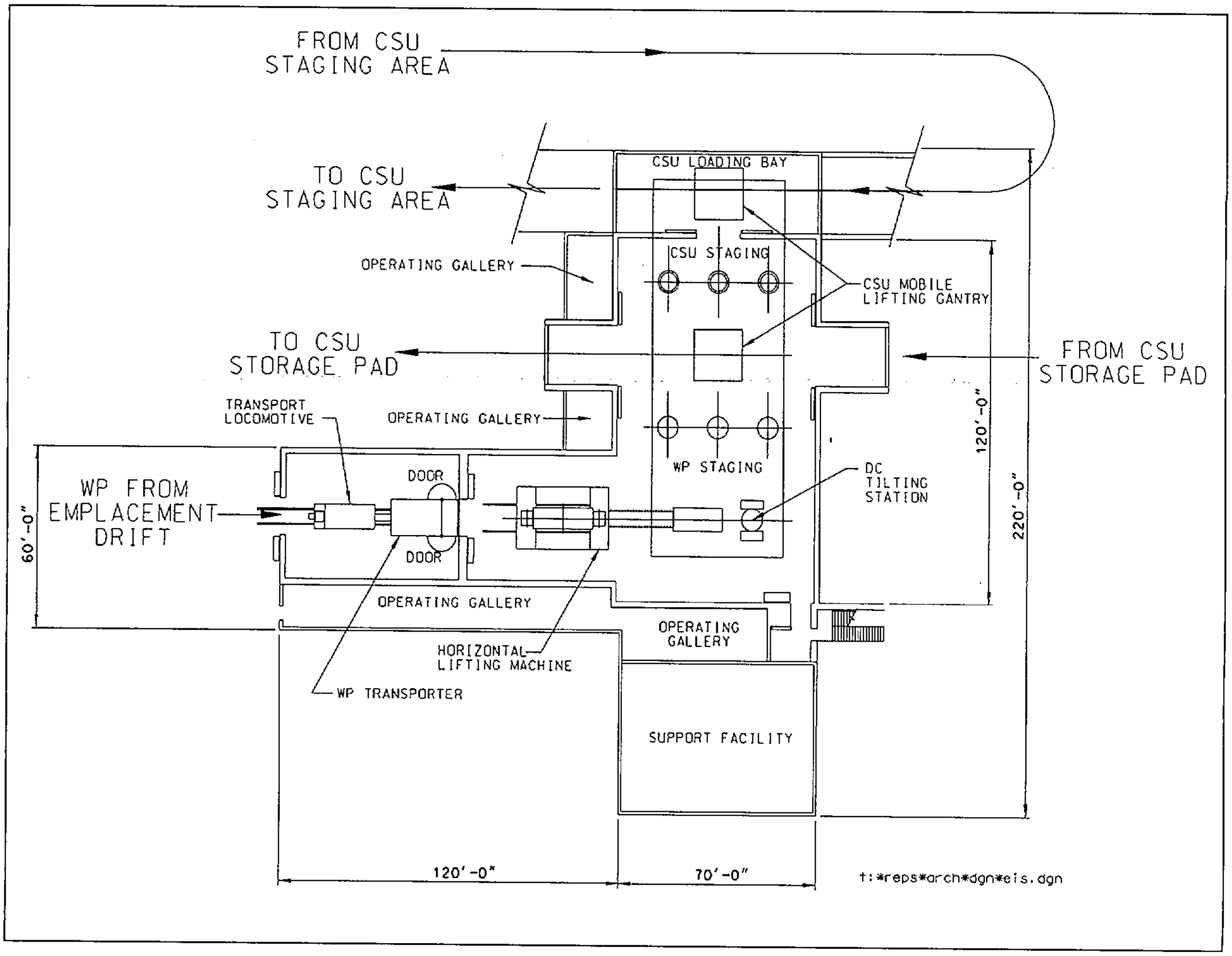


Figure I-6. Waste Retrieval Transfer Building Conceptual Design will be from the repository subsurface and the North Portal repository area to the Waste Retrieval Storage Facility. A new rail line 6,000 feet long will be constructed from the existing repository main gate to the Waste Retrieval Storage Facility.

The Waste Retrieval Storage Facility, including the concrete storage pad areas, are enclosed with a double security fence. A 200-foot buffer is provided between the CSUs and the security fence. A 2,300-foot distance is provided to the site boundary from stored waste packages. This distance effectively minimized the radiation impacts of the waste storage area operations upon members of the public.

5.3 WASTE RETRIEVAL TRANSFER BUILDING

The Waste Retrieval Transfer Building is shown in Figure I-6. Waste packages are received at the Waste Retrieval Storage Facility, staged in the waste package transporter queuing yard, and moved into the Waste Retrieval Transfer Building using the site prime movers. The waste package transporter is docked and secured for waste package transfer. The waste package is remotely transferred from the transporter to the waste package tilting station where the building overhead crane transfers the waste package to a vertical orientation. Three waste package staging positions are available in the shielded building. The waste package is normally transferred directly to a CSU base, unless an off-normal condition is encountered. Once the CSU upper shield is installed over the waste package, the CSU lid, cover, and locking plates are remotely installed (see Figure I-4). The CSU is then ready for transport to a concrete storage pad.

The empty CSUs are delivered by truck to the site, unloaded in the CSU staging area, transported to the Waste Retrieval Transfer Building, and staged in the CSU unloading bay using a mobile lifting gantry. The Waste Retrieval Transfer Building overhead crane transfers the empty CSUs into the shielded portion of the building for waste package loading.

A CSU mobile lifting gantry is used to transport the loaded CSU to its storage pad. Figure I-7 shows the general arrangement of the mobile lifting gantry for handling a CSU in the Waste Retrieval Transfer Building or on the concrete storage pad. The remotely operated mobile lifting gantry straddles the CSU, engages the CSU lifting bails, lifts the 110 ton CSU and waste package, transports the loaded CSU to its storage pad, positions the CSU on the pad (see Figure I-3), lowers the CSU onto the pad, and returns to the Waste Retrieval Transfer Building for another loaded CSU. This operation is normally repeated 4 times per day.

The CSU mobile lifting gantry design concept allows these functions to be performed in the 28-foot space between adjacent CSUs. The CSU mobile lifting gantry will be controlled using a broadband remote control technology, on-board visual monitoring, and remotely actuated mechanical systems.

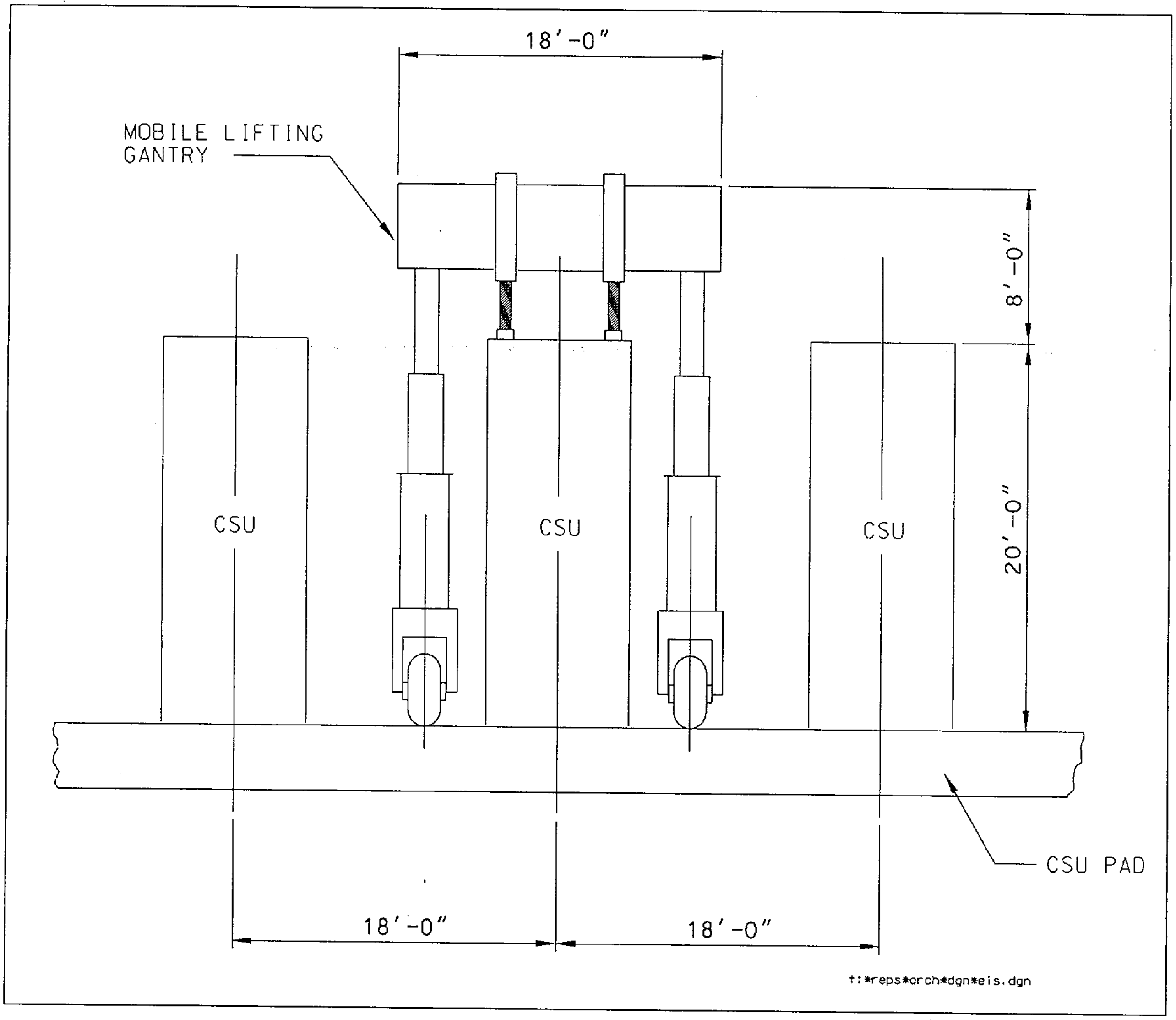


Figure I-7. Mobile Lifting Gantry General Arrangement

The gantry will be equipped with its own on-board power system, hoist mechanism, drive and steering equipment, and polyurethane drive tires for handling heavy loads.

The Waste Retrieval Transfer Building size is estimated to be approximately 200 feet wide by 220 feet long. The building has two perpendicular wings, one for waste package unloading and one for CSU loading and handling. The Waste Retrieval Transfer Building also includes an empty CSU unloading bay for staging and transfer of unloaded CSUs and an adjacent support facility. The estimated building footprint is 24,000 sq ft.

Since it is assumed the Waste Retrieval Storage Facility will only be built if retrieval is initiated, 100 years or more could elapse following emplacement. In the 2110 to 2133 period, significant technology advancement would be expected. The use of high-tech robotics, sophisticated remote systems, and electronic controls in the Waste Retrieval Storage Facility should be normal practice.

5.4 WASTE RETRIEVAL STORAGE FACILITY CONSTRUCTION

The Waste Retrieval Storage Facility will be constructed once the directive to retrieve waste is issued by the federal government. Required utilities for the Waste Retrieval Storage Facility include electric power, communications and water. Utility connections can be upgraded from the existing services at the repository North Portal area. The Waste Retrieval Storage Facility is not a complex facility and construction of the initial facilities is feasible in 2 years. The retrieval period would take approximately 10 years (See Section 4, p. I-6).

The concrete storage pads can be constructed sequentially as the waste retrieval operations proceed. The modular arrangement of the storage pad area shown in Figures I-2 and I-8 illustrates the build-out of the storage pads in 10,000 MTHM increments. Figure I-8 shows the topological arrangement of the seven increments and their respective grading and slope contours.

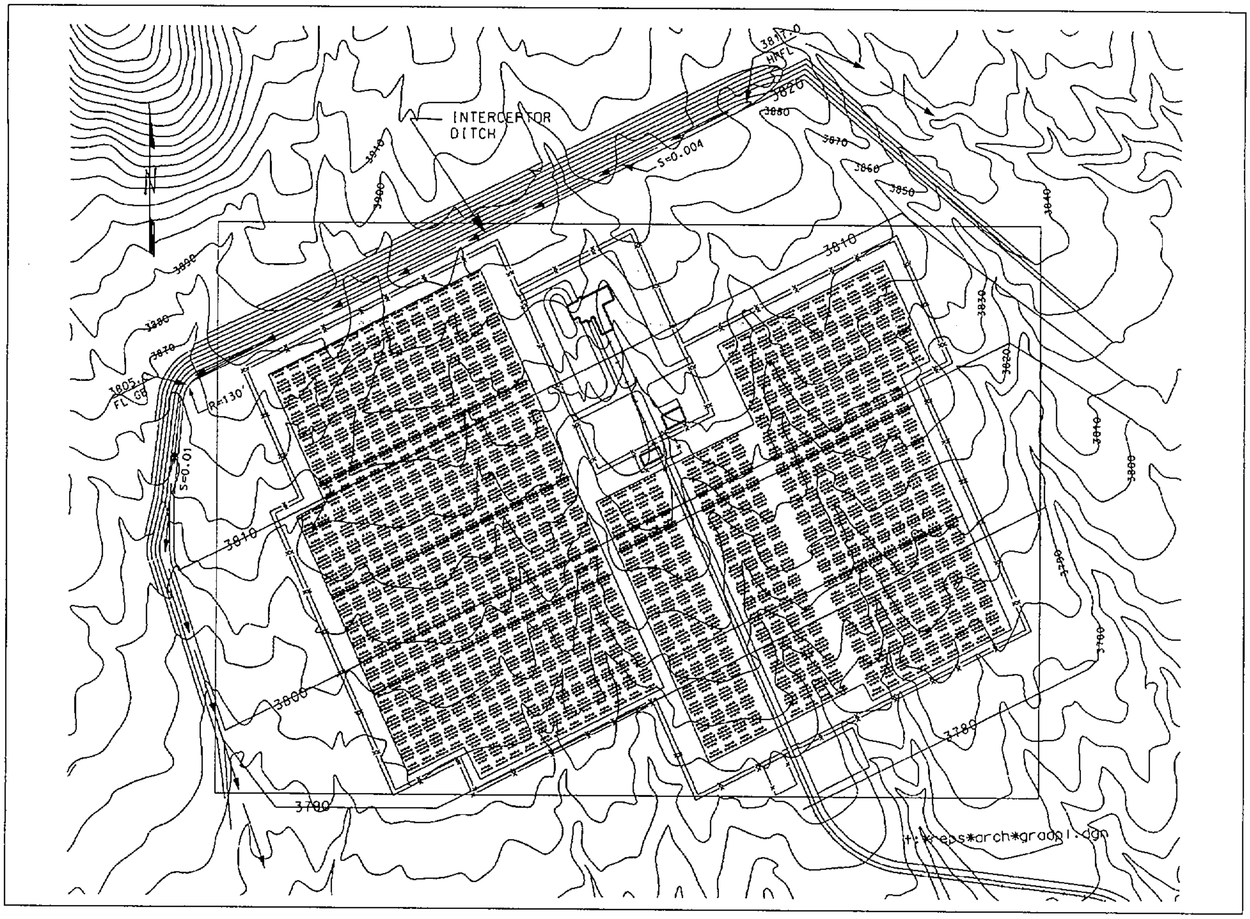


Figure I-8. Grading Plan and Construction of Retrieval Storage Area

6. RETRIEVAL CASE ENVIRONMENTAL DATA

This section includes tabular summary level engineering quantities (i.e., staffing, wastes, emissions, resources, and land use) for the waste retrieval case that address construction and retrieval operations.

6.1 CONSTRUCTION

The initial construction at the facilities needed to begin retrieval and storage of the repository waste inventory is expected to span about three years. Since construction is assumed to begin at the end of the Caretaker Phase, it is expected that none of the facilities that were built to support emplacement operations are usable, as these facilities will be over 100 years old.

Initial construction activities occur over 22 months and include site preparation, construction of nuclear and support facilities, and the initial verification testing of components and systems. The staffing, utility and resource usage, emissions, and site-generated waste will peak toward the middle of construction. Following construction, the retrieval operations staff will be hired and trained and cold start-up will be completed. Construction of storage pads will continue in a modular fashion during the Retrieval operations period.

The timeline for site construction and operations is as follows:

Activity	Duration
Initial site/pad construction	2 years
Retrieval operations	11 years
Pad construction concurrent with retrieval	7 years

Table I-2 contains the engineering quantities of interest to the EIS contractor for these construction activities. Data presented in this section do not include environmental impacts from start-up or the post-start-up construction.

A. Employment - work years (full-time equivalents) (FTEs) expended during construction, broken down by craft workers, construction management and staff, and peak annual employment.

B. Resources - materials consumed during construction, including utilities, concrete, steel, and liquid fuels, and utility consumption rate during a peak construction hour.

C. Wastes - total solid and liquid wastes generated during construction, including concrete, steel, industrial trash, sanitary wastewater, oils, and lubricants. The steel waste materials will be recycled as scrap material before completing construction. No radioactive or mixed wastes are generated during construction.

D. Emissions - Air pollutants emitted during the phase, including fugitive dust (from land clearing, site preparation, excavation, and other construction activities), exhaust from on-site vehicles during grading and construction activities, and exhaust from vehicles and buses delivering materials and workers.

The amount of land to be graded during this phase is expected to be that indicated in the Land Use area of the table. It is expected that the EIS contractor will estimate the closure emissions based on the construction staffing and the graded land area.

E. Land Use - site area disturbed during construction, including the area cleared for construction, laydown area for material and equipment storage, limited on-site fabrication for support of construction, and controlled receiving and staging for construction materials.

Table I-2. Surface Design Data for Retrieval Facility Construction (6 Years)

Employment	
Total for Phase	
Craft Workers	1,129
Construction Management & Staff	430
Total	1,559
Materials/Resources (Total for the Construction Phase unless noted)	
Utilities	
Electricity (MWh)	8,142
Well Water (1000 gallons)	168,264
Liquid Fuels (gallons)	386,500
Utilities (peak hour)	
Electricity (MW)	1.18
Well Water (gallons per day)	154,000
Solids	
Concrete (cubic yards)	705,907
Gravel (cubic yards)	100,994
Asphalt (cubic yards)	2,100
Steel (tons)	46,171
Industrial Gases (1000 scf)	1,111
Wastes Generated (Total for the Construction Phase)	
Solids	
Concrete, gravel and asphalt (cubic yards)	16,180
Steel (tons)	693
Sanitary/Industrial (cubic yards)	3,118
Recyclable (cubic yards)	7,795
Hazardous (drums)	2,168
Total trucks and buses to/from site	104,004
Land Use (acres)	
Retrieval Facilities and Storage Pad area for 70,000 MTHM	250

MW = megawatt
MWh = megawatt hour
scf = Standard cubic feet
MTHM = metric tons of heavy metal
Source: CRWMS M&O 1999, p. 12.

6.2 RETRIEVAL OPERATIONS

Repository retrieval operations are expected to span about 10 years for the baseline inventory and 17 years for the Module 1 and 2 inventories. Surface retrieval operations include waste receiving, waste preparation, (i.e., loading DC into a vertical storage unit), and support operations (e.g., maintenance, administration, security, utility supply, warehousing). After the initial ramp up, retrieval operations are generally steady over the entire retrieval period. Operations are planned for one shift per day.

Table I-3 contains the engineering quantities of interest to the EIS contractor for the retrieval operations activities. Data presented and described in this section includes the environmental impacts from the concurrent construction of the waste storage pads.

A. Employment - total employment (FTEs) for primary areas of the North Portal, including: Waste Retrieval Storage Facility, RCA site workers, administration, maintenance and supply, medical and fire, security, and other surface operating services.

B. Utilities - electricity, well water, and liquid fuels consumed during a peak emplacement year. Annual consumption and consumption rate during a peak hour are provided.

C. Emissions - peak annual air pollutants emitted during retrieval oeprations, including various gases used or generated as a result of the activities conducted in the surface facilities. Effluent streams are thoroughly scrubbed and/or filtered to remove or reduce the amount of undesirable particulates before they are released to the vent streams. Radioactive gases are not expected to be emitted, as the retrieved waste packages are expected to be intact.

D. Land Use - site area cleared to construct the surface facilities for retrieval. This area is shown on Figure I-8.

Table I-3. Surface Design Data for Retrieval Operations

Employment (Full-time equivalents [FTEs])	
Waste Retrieval Storage Facility	27
RCA Site Workers	2
Administration	12
Security	22
Maintenance and Supply	14
Medical/Fire	23
Other Services	8
Total	108
Utilities (Peak)	
Annual	
Electricity (MWh)	6,713
Well Water (million gallons)	17.7
Liquid Fuels (gallons)	455,990
Peak hour	
Electricity (MW)	726
Well Water (gallons per day)	126,300
Liquid Fuels (gallons per hour)	55

Source: CRWMS M&O 1999, p. 13.

Attachment II

Design Concept for a 10,000 MTHM Waste Staging Facility

CONTENTS

FIGURES

Page

TABLES

Page

1. PURPOSE AND SCOPE

The purpose of this attachment is to provide a conceptual design for a facility that will be used to temporarily store 10,000 MTHM of high-level nuclear waste. This Waste Staging Facility (WSF) will provide dry storage for both spent nuclear fuel (SNF) and vitrified high-level waste (HLW), and be designed to protect the health and safety of the public and workers, and to maintain the quality of the environment.

2. ASSUMPTIONS

A. The waste storage area is sized for 10,000 MTHM of SNF or vitrified HLW.

B. The waste will be stored dry in a storage configuration similar to the systems selected as a design basis for the Centralized Interim Storage Facility (CISF) (CRWMS M&O 1997d, Volume I, Chapter 4, similar to the figures listed on p. 4.0-xii).

C. The repository facilities will be used to receive the cask shipments and transfer the waste from the transportation casks into a form compatible with the vendor storage systems (i.e., new structures, like the CISF Waste Transfer Facility, will not be constructed).

3. SITE LOCATION AND DESCRIPTION

The WSF would be sited in the Midway Valley about 1.25 miles northwest from the North Portal waste handling facilities, as shown in Figure II-1. This area is well within the analyzed repository land withdrawal area and slopes from north to south at a grade of 3 to 4 percent.

The storage location was selected to be in Area 25, near the repository waste handling facilities. Facilities would be engineered to be above the probable maximum flood (PMF) elevation. The area is expected to be free from significant quaternary faults (i.e., faults that do not show evidence of more that five cm of movement in the past 100,000 years). It is relatively flat and has adequate storage space. The area is expected to have enough acceptable land available to store over 70,000 MTHM of waste.

It is expected that many of the site characteristics for the storage area will be similar to the characteristics of the nearby site selected for the repository surface facility. Additional site investigation work will be required to confirm the expected site conditions, including trenching to

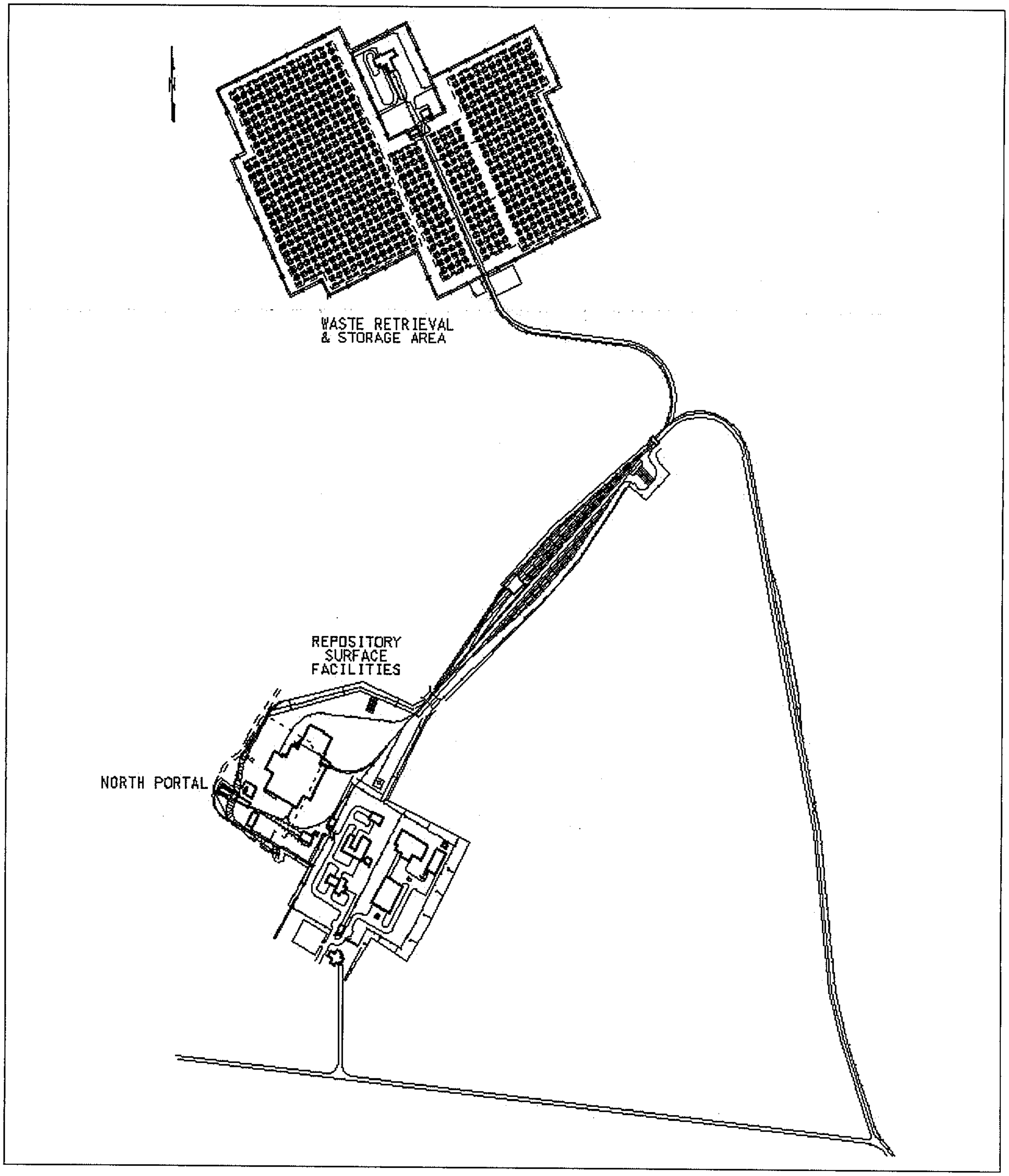


Figure II-1. Analyzed Site of the Waste Storage Facility confirm that the faults that extend from the North Portal pad to the selected site are not significant quaternary faults, and to determine the extent of the 100-year flood and PMF zones.

Confirmatory surveys are also required to ensure that the same conclusions reached regarding protected species, and historical, cultural and archaeological resources at the North Portal area apply to the storage site. Existing data are expected to demonstrate no impact to groundwater quality, wetlands, coastal zones and air quality.

4. CONCEPT OF OPERATIONS

4.1 WASTE STAGING

The WSF is a passive facility that provides dry storage with minimal operations. Waste will be stored in sealed, metallic canisters inside storage casks, or in transportable storage casks (TSCs). Any of several vender cask storage systems could be used. These systems use either a vertical storage cask that is placed on a reinforced concrete storage pad, or a canister that is placed in a horizontal storage module. Cask vendor systems for commercial SNF that currently considered for the CISF are listed below. Information about physical, thermal, and radiological monitoring characteristics of the cask/canister storage containers associated with these vender systems is shown in Table II-1. Vendor systems for the HLW and some DOE SNF forms have yet to be developed.

- Holtec International – HI-STAR 100 System
- Nuclear Assurance Corporation (NAC) STC System
- VECTRA NUHOMS® - MP187/HSM System
- Westinghouse Large/Small MPC System
- Sierra Nuclear Corporation (SNC) - TranStor™ System

Waste received in dual purpose canisters (DPCs) or TSCs will be stored in a compatible vendor storage system. Waste received as uncanistered waste will be stored in a single selected storage system.

The waste storage capacity would be exceeded early in the sixth year of waste receipt (cumulative exceeds 10,000 MTHM) if the facility receives waste at the following annual rates: 1200, 1200, 2000, 2000, 2700, and 3000 MTHM (CRWMS 1997q, Table 3.2-4, p. 22). The WSF would be constructed in a modular fashion as additional storage capacity is required.

Table II-1. Cask/Canister Storage Container Types

Parameter	HI-STAR	NAC STC	TranStor ™	HSM	W-S/MPC	W-L/MPC
Storage mode contents	Canistered MPC	Uncanistered Bare-fuel basket	Canistered MPC	Canistered MPC	Canistered MPC	Canistered MPC
Storage mode type	Cylindrical metal cask	Cylindrical metal cask	Cylindrical concrete cask	Concrete module	Cylindrical concrete cask	Cylindrical concrete cask
Construction	Multiwall – metal	Multiwall-metal	Cast concrete	Modular concrete	Modular concrete	Modular concrete
Storage orientation	Vertical	Vertical	Vertical	Horizontal	Vertical	Vertical
Lateral dimensions (feet)	8.0 Diameter	8.3 Diameter	11.3 Diameter	19.8/9.7 L/W	12.2 Diameter	13.6 Diameter
Height (feet)	16.9	16.1	17.7	15	20.5	20.5
Max. weight (loaded) (lbs.)	Not Known[1]	232,950	290,000	305,680	340,000	390,000
Max. weight (unloaded) (lbs.)	Not Known[1]	193,300	213,620	236,000	259,800	306,110
Heat removal (watts)	36,480	22,100	26,000	24,000	13,440	23,500
Storage Surveillance/monitoring requirement	Visual	Visual & pressure	Visual & temp.	Visual & temp.	Visual & temp.	Visual & temp.
Transporter type	Vertical	Vertical	Vertical	Horizontal	Vertical	Vertical

Source: Table from *Centralized Interim Storage Facility Topical Safety Analysis Report* (CRWMS 1997d, Table 4.2-1, p. 4.2-21)
[1] Vendor proprietary data.

4.2 WASTE RECEIPT AND TRANSFER OPERATIONS

The operations required to receive the waste shipments and place the waste in storage depend on the specific vender storage system. A generic description of these operations follows.

4.2.1 Transportation Casks Containing Uncanistered Waste

A cask is received and transferred to an assembly transfer system unloading pool in the WHB, opened, and transferred to an underwater staging rack, as is done for uncanistered waste received for emplacement. Refer to Section 4 of the main body of this report. When enough compatible SNF assemblies have been accumulated to fill a storage canister, an empty storage canister is loaded into a transfer cask and placed in the pool. The storage canister is loaded from the lag storage rack and is sealed under water. The transfer cask is then removed from the pool transfer area and taken to the canister transfer area, located between the canister transfer lines and the carrier bay. The canister is transferred to either a vertical storage cask or to a horizontal transporter using the equipment designed by the storage system vendor. A vertical storage cask is then hauled to the WSF and placed on the storage pad. A horizontal canister is hauled to the WSF in a shielded transporter and inserted in a storage module.

4.2.2 Transportation Casks Containing Canistered Waste

A cask is received and transferred to a canister transfer area within the WHB, prepared and opened, as is done for canistered waste received for emplacement. Refer to Section 4 of the main body of this report. The canister transfer area is located between the carrier bay and the canister transfer lines. The canister is transferred from the cask to either a vertical storage cask or to a horizontal transporter using the equipment designed by the storage system vendor. A vertical storage cask is then hauled to the WSF and placed on the storage pad. A horizontal canister is hauled to the WSF in a shielded transporter and inserted in a storage module.

5. WASTE STORAGE PAD LAYOUT AND DESCRIPTION

Figure II-2 shows a layout of the potential temporary storage area. This is the only additional facility required for early receipt of SNF and HLW. The total amount of stored waste will be 10,000 MTHM. Reinforced concrete pads will be provided for vertical storage casks and concrete storage modules will be provided for horizontal storage canisters.

Vertical storage casks sit on reinforced concrete pads 80 feet by 60 feet and 3 feet thick. Each vertical storage pad will be capable of storing eight storage casks. Reinforced concrete pads 40 feet wide and 101 to 104 feet long will support horizontal storage modules. Each horizontal storage pad will contain up to 20 VECTRA NUHOMS System horizontal storage modules (CRWMS 1997d, Volume 1, Book 2, Chapter 7, Figure 7.6-1).

Storage of 10,000 MTHM of SNF and HLW will require up to 1,400 vertical casks or 100 horizontal storage modules, depending on the vendor system design (canister capacity). In Figure II-2, 175 vertical storage pads and 5 horizontal storage pads are shown. The mix of vertical and horizontal storage modules may vary as vendor systems are defined.

The vertical storage pad rows are spaced 50 feet apart for access roads and the horizontal storage pads are spaced so that there are at least 100 feet between the modules allowing maneuverability of transfer trailers. The concrete storage pads can be constructed sequentially as the SNF and HLW transportation casks arrive. A 200-foot buffer is provided between the storage casks and the security fence and a 2,300-foot distance is provided to the site boundary from stored SNF. These distances minimize the radiation impacts of the waste storage area operations upon the site employees and the public.

Utilities for the storage yard will include electric power, communications and water. All needed utilities can be provided from the services at the North Portal area.

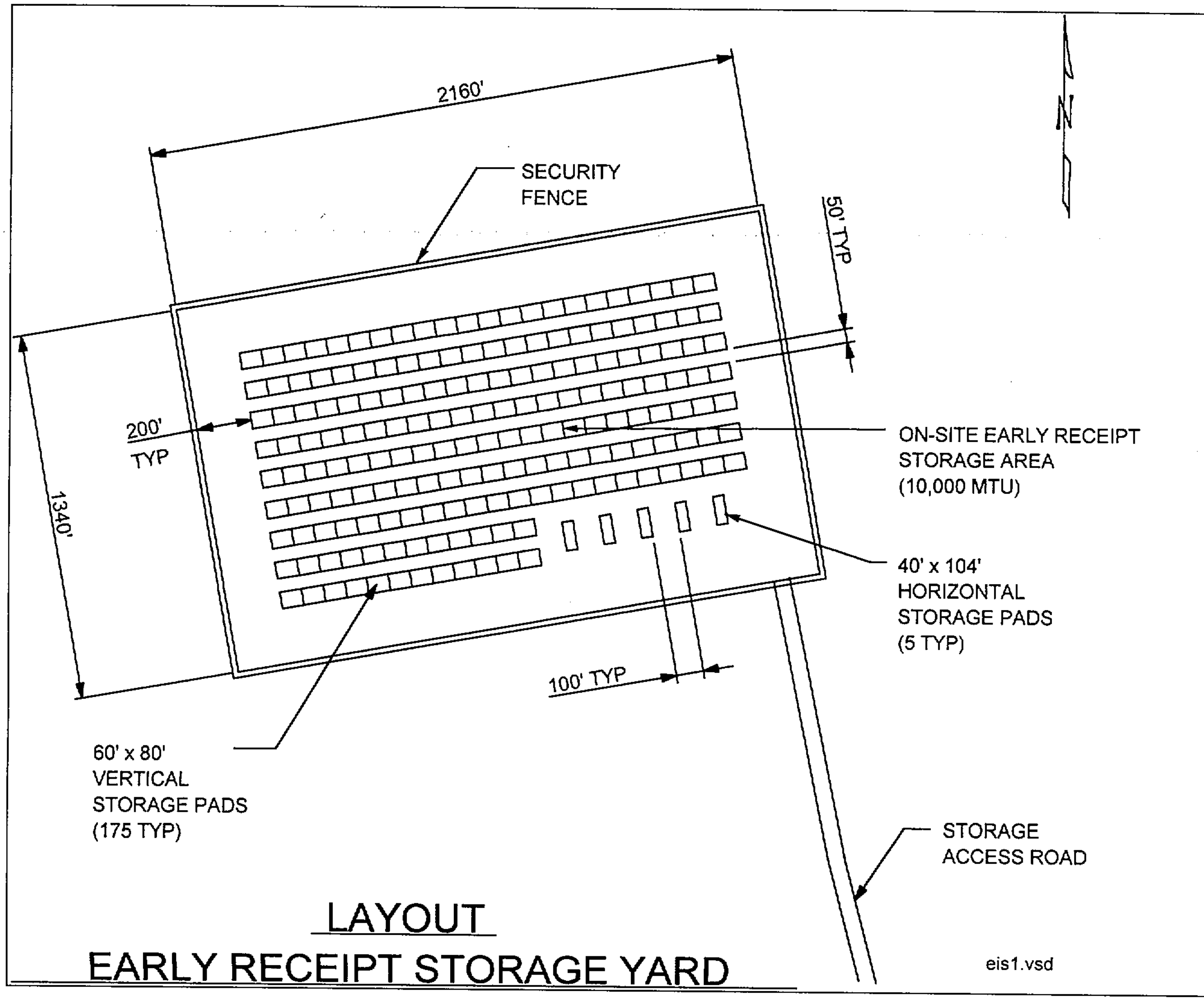


Figure II-2. Potential Temporary Storage Area Layout

Attachment III

MGR Cask Maintenance Facility

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

FIGURES

Page

TABLES

Page

1. PURPOSE AND SCOPE

The purpose of this attachment is to provide the engineering files for a Cask Maintenance Facility (CMF) required to support the Environmental Impact Statement (EIS). A description of the CMF design concept, support systems, and operations, previously developed for the Monitored Geologic Repository (MGR), is included. In this attachment, cask maintenance is defined as the test and certification, incidental repair, modification, and record keeping required for the Civilian Radioactive Waste Management System (CRWMS) shipping cask fleet during the Emplacement Operations Phase of the program. Cask tests and certification will be scheduled in accordance with the CRWMS transportation program authority and are defined herein. Cask maintenance and certification begins any time after the start of emplacement and concludes at the completion of emplacement. During emplacement operations, casks are moved by the Carrier/Cask Transport System to/from the Waste Handling Building (WHB), the Carrier Preparation Building (CPB), and other locations within the Radiologically Controlled Area (RCA) of the MGR. The casks are moved to the CMF, and returned to the required RCA location, depending on the operation performed. The CMF stages transportation casks (routinely empty casks) as required to perform the cask operations. The waste and casks are handled in a manner that protects the health and safety of the public and workers, is in accordance with the principle of as low as reasonably achievable (ALARA), and maintains the quality of the environment. The CMF design consists of a facility that includes the equipment required for inspection, repair, refurbishment, and staging, including incidental handling of all cask and waste types. The design, construction, operation, and environmental data associated with the CMF are provided in Section 6.0 of this attachment.

1.1 BACKGROUND

The *Draft 1988 Mission Plan Amendment* (DOE 1988) indicated that the Office of Civilian Radioactive Waste Management (OCRWM) shall have a "transport capability" and that a "fleet operational" condition shall occur.

The CMF presented in the *Mined Geologic Disposal System Advanced Conceptual Design Report* (ACD) (CRWMS M&O 1996a, Section 7.2.3, pp. 7-132 through 7-177) is the basis for the MGR CMF, which is described herein. During ACD design, a simulation model was developed to ensure proper facility sizing for a cask receipt rate necessary to support operations. The simulation model results are described in Section 5.3, CMF Simulation Results.

Following the ACD design, the CMF was moved off-site as the responsibility of the Regional Service Contractor (RSC), but is included in this report in the event the facility is moved back to the MGR. The operations required to certify transportation casks and remediate cask anomalies are assumed to be unchanged; therefore, the CMF design as described in the ACD (CRWMS

M&O 1996a, Section 7.2.3, pp. 7-132 through 7-177) is judged to be adequate as the basis for this report. The most recent reference design cask fleet projections are included in the report in order to make adjustments to the type and quantity of casks that will be handled by the facility on an annual basis. Adjustments to the cask fleet are included in the estimates and were used to develop the CMF facility manpower and shift operations, and other data required in these engineering files.

1.2 MISSION

Transportation casks and associated ancillary equipment (personnel barriers, impact limiters, and certain contaminated transport vehicle equipment) must be maintained in proper condition to maintain transportation cask and carrier system operational effectiveness and safety. The basic mission of the CMF is to perform the following tasks for casks, carriers, and components:

- Testing
- Routine maintenance, repair, and modifications
- Configuration control
- Preparation for cask decommissioning and disposal
- Maintenance and dissemination of cask records

Maintenance of transport vehicles is limited to activities required to prevent above-normal exposures to the general public.

2. CMF ASSUMPTIONS

This section lists the controlled and non-controlled design assumptions applicable to the design of the CMF, as stated in the ACD (CRWMS M&O 1996a, Section 7.2.3, pp. 7-132 through 7-177). Assumptions specific to this report address primarily the impacts of the cask fleet size, which differs from the cask fleet size presented in the ACD.

2.1 ADVANCED CONCEPTUAL DESIGN (ACD) DESIGN ASSUMPTIONS

The following assumptions have been withdrawn, but are included herein as the basis for the CMF as it was developed for ACD.

2.1.1 Transportation Cask Fleet Maintenance Frequency

- Maintenance requirements for the transportation fleet will be comparable to the maintenance requirements for existing casks.

- A truck cask is serviced a maximum of three times per year. During one visit, the Certificate of Compliance inspection is performed.

- A rail cask is serviced once per year during the Certificate of Compliance inspection.

2.1.2 Cask Maintenance Operations

CMFs may be integrated into related facilities rather than in a separate, stand-alone structure.

2.1.3 Transportation Cask Fleet

The cask fleet inventory is based on a sealed canister system (multi-purpose or dual-purpose) and is depicted in the tabular data contained in Section 5.5 (Refer to Section 2.2.2).

2.1.4 Non-Controlled Design Assumptions

For the ACD report, eight percent of the loaded shipping casks received at the repository are assumed to require external surface decontamination prior to the unloading of waste forms in the WHB.

2.2 ASSUMPTIONS SPECIFIC TO THIS REPORT

2.2.1 CMF Location

The CMF will be relocated to the MGR at a location that is to be determined.

2.2.2 Cask Fleet Size

The cask fleet size will be adjusted to the current reference design estimates. The most recent cask fleet size is presented in Section 5.5, Engineering Files Cask Fleet Assumptions, and is included in the assessment of EIS-related data.

2.2.3 CMF Shift Manpower

Shift manpower for the CMF will be essentially as defined for the ACD design. The number of shift operations are adjusted in this report to accommodate the current reference design cask fleet. The current CMF cask fleet is presented in Section 5.5, Engineering Files Cask Fleet Assumptions, and is included in the assessment of EIS-related data in Section 6.

2.2.4 Decontamination

The WHB will perform most cask decontamination activities during normal operations, where cask repair or certification is not required. In the ACD design, the majority of the cask decontamination operations were performed in the CMF. For this report, it is assumed that much of the cask decontamination due to weeping (for loaded casks) will be performed in the WHB.

3. CMF REQUIREMENTS

3.1 REGULATORY REQUIREMENTS

3.1.1 General

General design requirements for repository surface facilities are defined in the ACD, Section 7.2.3, pp. 7-132 through 7-177, and are outlined in this section:

3.1.2 Radiation

- Radioactive contamination limits on the external surface of each shipping cask are:

Beta-gamma radionuclides	22 dpm/cm^2	10^{-5} uCi/cm^2
All alpha radionuclides	2.2 dpm/cm^2	10^{-6} uCi/cm^2

- The radiation dose rate at each accessible surface of the shipping vehicle shall be 0.5 mrem or less per hour, and shall have no significant surface contamination.

- The radiation at the interior of the shipping vehicle shall not exceed 10 mrem per hour, or 2 mrem per hour at 1 m (3.3 feet).

3.2 DESIGN REQUIREMENTS

CMF functional requirements form the basis for the ACD CMF design and are summarized in this subsection:

3.2.1 Maintain Transportation Fleet

- Comply with the applicable requirements of 10 CFR 71, Subparts A, G, and H
- Provide facilities and features to ensure that cask subsystems are maintained
- Provide for one cask visit per year for certification and major maintenance

3.2.2 Record Status of the Transportation Fleet

- Maintain records of cask tests/inspections and maintenance per 10 CFR 71, Subparts G and H. Include cask usage, component inventories, and all work records.

- Provide for the retrieval and dissemination of cask records.

3.2.3 Decontaminate Transportation Cask Subsystems

- Maintain cask interior and component contamination as agreed to with the purchasers

- Decontaminate external cask surfaces in accordance with 49 CFR 173.443 Table 11

- Decontaminate cask external surface such that no significant removable surface contamination exists per 10 CFR 173.443.

- Decontaminate ancillary equipment, tools and fixtures external surfaces such that they can be packaged as low specific activity material

3.2.4 Handle Casks

Move and lift cask system components to the appropriate position in the CMF and onto transporters or other transfer equipment.

3.2.5 Test and Inspect Casks

Provide inspection of cask subsystems per 10 CFR 71.93(b) or transportation system requirements prior to release for shipping. The tests and inspections shall include:

A. Radiological inspection

B. Nondestructive examination for wear, corrosion, damage or failure, including:

1. Cask interior and exterior (including seals)
2. Fuel assembly basket
3. Impact limiters (including bolts, keys, and all fittings)
4. Closure stud tensioner system (including fittings)
5. Transporter, skid, tie-downs, personnel barrier, and deck
6. Ancillary equipment, tools, fixtures, and bolts

C. Inspections pursuant to the Certificate of Compliance, Safety Analysis Report, and the transportation system requirements, including:

1. Head seal leak and hydrostatic tests
2. Thermal and heat dissipation test
3. Neutron absorber presence measurement
4. Trunnion and lift lug load, liquid penetration, ultrasonic, and radiographic tests
5. Component fit and clearance
6. Plug seal integrity and moisture content of impact limiters

3.2.6 Repair or Replace Transport System

A. Perform component replacements, as required, for:

1. Closure seals, fasteners, and retainer clips
2. Threaded fasteners, such as closure bolts or studs

3. Vent valves, fittings, and valve box
4. Fusible plugs and threaded inserts
5. Trunnions and trunnion bolts

B. Evaluate damaged or degraded casks for operability and prepare casks or canisters for decommissioning and disposal

3.2.7 Reconfigure Casks

- Remove and install fuel baskets for casks with removable baskets
- Remove and install fuel spacers

3.2.8 Store Tools and Spare Parts

- Store contaminated baskets and spacers with radiation in excess of 100 mrem at a distance of 30 cm.

- Store empty SNF canisters

- Store spares, tools and fixtures for transportation casks and SNF

- Store tools, fixtures, equipment, and SNF canisters with removable contamination

4. CMF OPERATIONS

4.1 FACILITY OVERVIEW

The CMF is a three-floor concrete and steel structure with approximately 116,000 square feet of gross floor area. The ACD report placed the CMF just east of the WHB; however, since the facility was moved off-site, it is not located in this report. The facility layout is shown in Figure III-1, Cask Maintenance Facility Floor Plan and Building Section.

4.2 OPERATIONS

Incoming casks are received in the WHB Carrier Bay and transported by site prime mover (SPM) to a CMF air lock (Identified as Location 37 on Figure III-1). Casks are removed from the carrier with a 125-ton (larger for the current cask fleet) crane and placed in a preparation and decontamination pit (Locations 50 and 52).

A shroud and bottom protector are installed to reduce contamination when the cask is placed in the pool (Location 51). The cask is purged of interior gases and filled with water, the head is loosened, and the head removal adaptor is installed. The cask is then lifted into the reconfiguration pool and placed on the pool shelf. A yoke extender is added for lowering the cask into the pool, and the fixtures are removed when the cask is in place. The cask head is transferred to the decontamination pit (Locations 50 and 52) for inspection, repair, or decontamination. The interior of the cask is inspected and wet vacuumed. The spacers and baskets are removed by the pool bridge crane, and the interior of the cask is inspected and vacuumed again. Spacers and baskets are moved to the basket cleaning area near the basket storage pool (Location 53), are cleaned, and are then moved to the pool storage area.

Spacers and baskets are replaced as required, and the extended yoke is re-attached. The cask is lifted to the pool shelf, and the cask interior and sealing surfaces are inspected. The cask is lifted from the pool, and the shroud and bottom protector are removed as the cask is being placed in the preparation and decontamination pits (Locations 50 and 52). The cask exterior is surveyed and decontaminated as required. Repairs to seals, fasteners, and internal components are performed as required. The head is re-installed prior to the water being removed from the cask. The cask is vacuum dried and then pressurized with an inert gas.

The cask is leak tested, and transferred into the Test, Inspection, Maintenance, and Repair area (Locations 40 and 41). Within this area, the casks undergo dry test and repair to external surfaces, mechanical welding, grinding and non-destructive examinations as required. Completed casks are placed on a cask carrier for movement into the shipping and receiving bays of the Carrier Preparation Building (CPB) or the Waste Handling Building (WHB), depending on the operations or cask destination.

Appendix III-A contains a list of block diagrams produced in the ACD that show the functional detail of Cask Maintenance, Preparation, Recertification, Decontamination, Component Repair, External Repair, and the Pool Purification System.

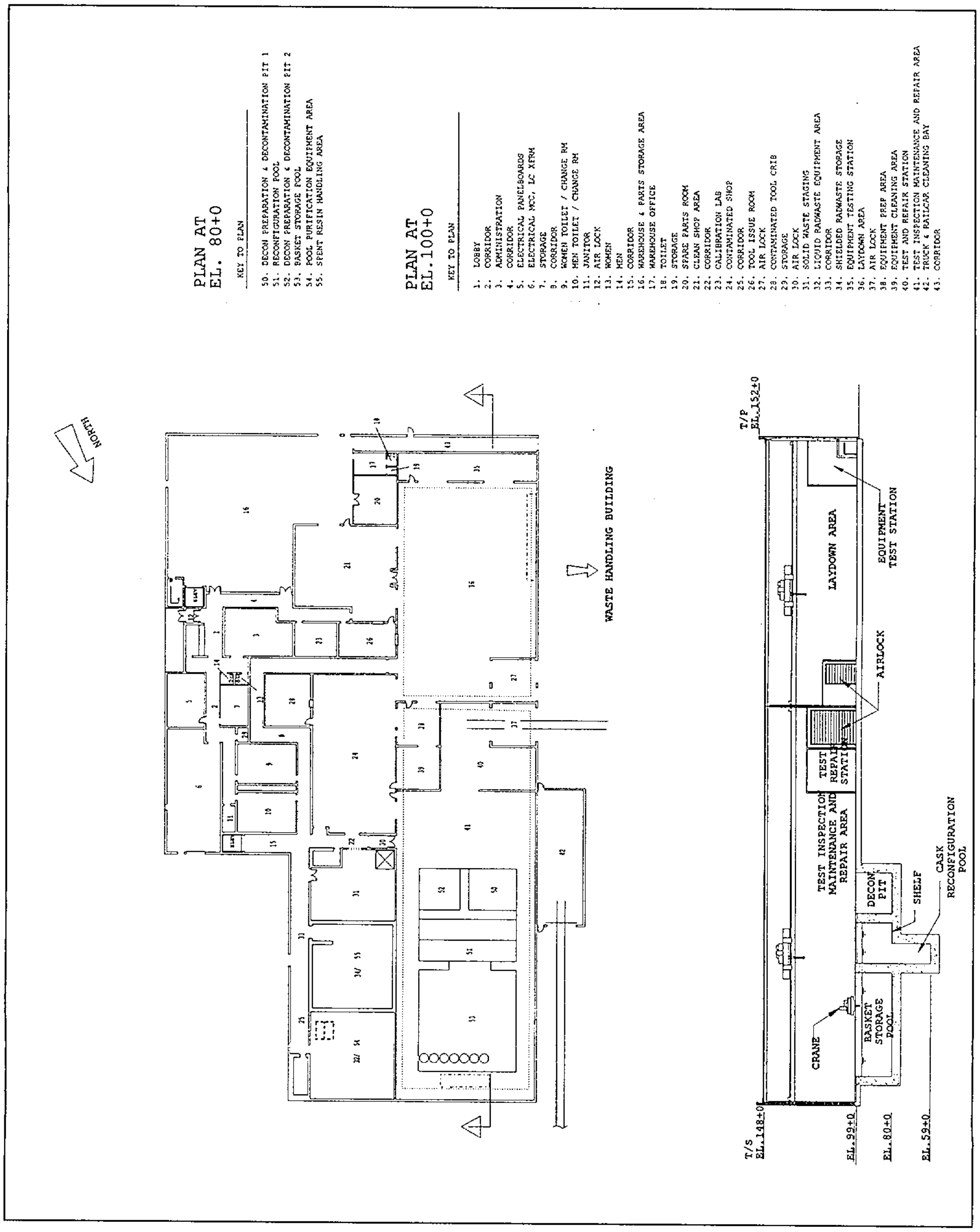


Figure III-1. Cask Maintenance Facility Floor Plan and Building Section

5. CMF FACILITY DESCRIPTION

The ACD CMF facilities, systems, and operational concept were developed in accordance with the requirements in Section 3.0, CMF Requirements. The three-floor concrete and steel structure has an overall building footprint of approximately 360 feet by 226 feet, and is shown in Plans (CMA-SK-001 through SK-004), Section (CMA-SK-005), and Elevations (CMA-SK-006) (See Appendix III-A).

5.1 CMF AREA DESCRIPTIONS

The two-story CMF, with basement, contains the primary operational and support areas that are summarized in the following subsections.

5.1.1 Test, Inspection, Maintenance, and Repair Area (Location 41)

The dry test and repair station accommodates test/repair to cask surfaces or cavities where access is provided. An overhead crane handles casks and equipment, supported by a 15-ton jib crane, and a mobile platform allows personnel access to casks. Helium leak tests, venting, sampling, and purging are performed at the station. The station is also equipped to inspect threaded inserts, and provide external repair using hand portable tools. Welding equipment makes repairs, as necessary, and includes nondestructive testing.

5.1.2 Preparation and Decontamination Pits (Locations 50 and 52)

The preparation and decontamination areas include mobile personnel platforms, spraying and scrubbing tools, and radiation instruments to support cask survey and decontamination (decon). Also included are manifolds, drains, and test apparatus required to drain, vent, vacuum, and purge casks, and perform leak tests. Inert gas and air tools are provided at each pit for cask closure, repair, and replacement of seals, connections, fasteners, valves, vents, and fittings. Cask head support and handling stands enable inspection and seal replacement. Hydrostatic and fluid measurement equipment are provided to service cask cooling and shielding systems. Pit surfaces, work stands, and fixtures are designed for decontamination, and are drained into a floor drain collection tank which is transferred to the Waste Treatment Building (WTB).

5.1.3 Reconfiguration and Basket Storage Pool (Locations 51 and 53)

Cask reconfiguration and interior cleaning are performed in the reconfiguration pool adjacent to the preparation area. The pool is stainless steel lined with two floor levels; a shelf level deep enough for an upright cask; a deep pool area that accommodates the cask height plus a basket; and added depth for personnel shielding. Closed circuit television and lighting support remote operated tools for bolting, unbolting, torquing, and submersible vacuum cleanup equipment. The pool crane travels the pool expanse, and accommodates lifting fixtures for cask heads and baskets.

5.1.4 Truck and Railcar Cleaning Bay (Location 42)

Truck and railcar maintenance occur in the truck/railcar cleaning bay, where components of truck or rail transporters are cleaned, inspected, and repaired. Solid and liquid low-level waste are packaged for transfer to the WTB. Maintenance is performed only on structural components. Components such as tires, brakes, bearings, hydraulics, and railcar trucks are serviced elsewhere.

The following operations are performed in the cleaning bay:

- Perform radiation surveys
- Remove road dirt and provide for wiped down
- Beadblasting is limited to minor paint removal and weld preparation
- Weld repairs to the structural components

5.1.5 Clean Shop (Location 21)

The clean shop maintains facility equipment and components. Minor machining, inspection, and repair are performed with equipment including a milling machine, cranes, lathe, parts cleaner, welder, drill press, fork lift, press, metal cutter, and miscellaneous instruments, and tools.

5.1.6 Tool Issue Room (Location 26)

The tool room provides storage and inventory control for tools and consumables, including machine and hand tools (grinders, drills, wrenches etc.), fasteners and hardware, and other consumables.

5.1.7 Contaminated Shop (Location 24)

The shop performs work on contaminated cask components. Work is limited to items such as valves, connectors, and hand tools of 50 lbs or less. Gloveboxes provide for inspection, repair or rebuilding items supported by enclosed polishing and decon tanks and work benches. Contaminated items are decontaminated and moved to the clean shop. Radwaste is collected and routed to the WTB.

5.1.8 Contaminated Tool Crib (Location 28)

The crib is a controlled storage area for tools that are not easily decontaminated. The tools are cleaned and packaged for re-use or disposal.

5.1.9 Laydown Area (Location 36)

The area provides for staging, inspection, and repair of components such as personnel barriers, impact limiters, tiedowns, transporter skids, saddles, yokes, and ancillary devices. An overhead bridge crane services the laydown area.

5.1.10 Equipment Testing Station (Location 35)

This station is a clean (uncontaminated) area, and provides load tests for lifting equipment, including trunnions, yokes, slings, and adapters; and humidity checks on impact limiters. Leak and pressure tests are performed on valves and special tools, as well as on welds and handwork.

5.1.11 Equipment Cleaning Area (Location 39)

This area provides the environment and the apparatus required to clean and decon equipment, which consists of two sections: the equipment prep area, and the equipment cleaning area. Contaminated items arrive in packages, the prep area door is closed, and the items checked for contamination. Contaminated items are moved to the cleaning area, and returned to the prep area. Items within contamination limits are packaged and sent to operations or storage. Solutions, tempered water, and spray equipment are part of he decon supply system. Radwaste is packaged, or collected by the drains radwaste system, and routed to the WTB.

5.1.12 Warehouse and Parts Storage Area (Location 16)

The warehouse provides storage for spares, including CMF, and certain cask components, including shipping boxes to support cask systems during shipping campaigns. Items are cleaned, as required, and packaged in the cleaning area before entering the warehouse. The warehouse contains approximately 8,200 square feet for spares and box storage, offices, campaign boxes, and a handling area for campaign boxes and spare parts. A truck dock is located at the southwest corner, and rail access is located at the laydown area.

5.1.13 Calibration Lab (Location 23)

Measuring equipment, gauges, and tooling that are free of contamination, and require scheduled certification, or repair are handled in this lab. Ultrasonic, magnetic particle, and dye penetrant inspection equipment is also stored in this area.

5.1.14 Additional Support Areas

Administrative areas are located so that personnel working in the CMF check in at the personnel support area and proceed to their work place. If special clothing is needed, personnel dress in the locker room. Personnel exiting the facility are checked for contamination. Other support systems such as cooling towers, plant air, and chilled water systems are centrally located at the site and service all facilities, including the CMF.

5.2 ARCHITECTURAL AND STRUCTURAL DESIGN

Construction materials and finishes for the CMF will be durable, low maintenance and adaptable to decontamination where appropriate. Materials will conform to applicable American National Standards Institute and Underwriter's Laboratory standards. The architectural design will be in accordance with state and local building codes for the site selected.

The structural design considered the service loads and those associated with natural phenomenon The minimum live loads specified in the Uniform Building Code were used; actual loads need to be verified. The facility laydown area consists of spread footings, concrete slab on grade, and a structural steel superstructure. The laydown and test inspection areas are serviced by 200-ton cranes supported by structural steel. Shipping cask loads developed during VA Design are up to 150 tons.

Walls and floors of the preparation, reconfiguration pool, basket storage, pool equipment, and spent resin handling areas are reinforced concrete. The interior surfaces are lined with 1/4-inch stainless steel plate. The remainder of the facility consists of concrete spread footings, slabs on grade, structural steel superstructure, masonry or concrete walls, and lightweight partitions. Load and strength factors for reinforced structural members were in accordance with the American Concrete Institute Code. Structural steel is designed to the American Institute of Steel Construction American Structural Design manual, using the allowable stress design method.

The ACD design considered service, seismic, and tornado generated missile loads. Extreme wind and other loading conditions will be considered in future design.

5.3 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

The CMF HVAC system provides controlled environmental conditions for the facility handling and support equipment, and the safety, and comfort of operating personnel. Design details of the system are presented on HVAC Flow Diagrams CMH-SK-101, 102A, 102B, 103A through E (See Appendix III-A).

5.3.1 Confinement Zones

The HVAC system confines radiation close to the point of origin, and prevents releases to areas occupied by personnel. Confinement is accomplished by a series of confinement zones, each of lower pressure, and a higher potential for contamination, as shown on CMH-SK-104A through C (See Appendix III-A).

The primary zone system is at the lowest pressure, and ventilates the cask handling areas through high efficiency particulate air (HEPA) filters, then out through the final exhaust air system. The secondary zone system, is at a higher pressure than the primary, and ventilates potentially contaminated areas such as contaminated equipment shops, radwaste area, solid waste handling, cask pool area, preparation/decontamination pits, test and repair stations, spent resin area, pool equipment area, and exhausts out through the final exhaust air system. The tertiary confinement zone include enclosures and rooms that do not have contact with the primary zone area, but may become contaminated, such as equipment laydown, testing, and yoke storage areas, and corridors.

Other support areas of the facility do not have a potential for contamination, are designated neutral areas, and are maintained at a higher pressure than the adjacent tertiary zone. The system prevents these areas from becoming more negative than the tertiary zone.

5.3.2 HVAC Support Systems

Normal, standby or emergency electric power are provided to operate HVAC components such as during normal and off-normal operation. Instrument air is provided to operate instruments and pneumatic operators, and chilled water provides air cooling. Fire protection panels, smoke and temperature detectors are included to activate fire dampers in the ductwork or initiate the HEPA protection deluge systems that are integral to the ventilation system.

5.4 CASK THROUGHPUT SIMULATION RESULTS

5.4.1 Simulation Approach

A computer model was developed during ACD to perform CMF cask maintenance activities. Cask handling activities and durations, the handling equipment, and the areas where casks will be worked (known as "resources") are defined in the model.

Cask arrival rates are defined, and as a cask moves through the model, the resources are either seized, or the cask waits for the resource, and is released when the operation is finished. The outputs of the model include the time a cask spent in the CMF, the time a cask waited for each resource, the number of casks that waited for the same resource, and the utilization and availability statistics for each resource.

5.4.2 CMF Areas Modeled

Equipment and areas modeled within the CMF include the following:

- Staging, Inspection, and Pool area cranes
- CMF cask carrier
- Preparation and decontamination pits
- Deep pool, and pool shelf spaces.
- Cask inspection, reconfiguration and cleaning areas
- Fuel spacer storage areas
- Basket storage and cleaning spaces

5.4.3 Cask Arrival Rates

Cask arrival rates were developed for a Canistered Waste and an All-Bare-Fuel scenario.

5.4.3.1 Canistered Scenario

- 72 rail casks/year for decontamination or Certificate of Compliance
- 36 truck casks/year (12 cask fleet); maintenance three times/year/cask
- 47 rail casks and 5 truck casks (in addition to 1 and 2) decontaminated for weeping (removable exterior contamination)

5.4.3.2 All-Bare-Fuel Scenario

- 150 rail casks/year (50 cask fleet); maintenance three times per year per cask
- 105 truck casks/year (35 cask fleet); maintenance three times per year per cask
- 41 rail and 27 truck casks (in addition to 1 and 2); decontaminated for weeping (arrive with removable exterior contamination)

5.4.4 Simulation Results

The model assumed each cask arrived on a uniform schedule. One- and two-shift operations (each five days per week) were simulated, and an allowance was made for the CMF to be unavailable 20 percent of the year for maintenance. The canister-based scenario handles the required 160 casks per year, and the all-bare-fuel scenario handles the required 323 casks per year, which is approximately double that of the canistered case. The ACD simulation results are defined in ACD Section 7.2.3, pp. 7-132 through 7-177, and are summarized as follows:

Average Time Spent in the CMF (hours)

	Canistered Fuel		Bare Fuel	
Cask Type	**2 Shifts**	**1 Shift**	**2 Shifts**	**1 Shift**
Scheduled rail casks	44.2	55.2	60.7	NA
Scheduled truck casks	34.3	47.3	58.5	NA
Weeping rail casks	17.7	27.8	33.0	NA
Weeping truck casks	21.0	27.7	34.3	NA
All casks	33.3	44.5	54.2	NA

The simulation was unable to finish the Bare Fuel scenario for single-shift operation; that scenario is considered not feasible, unless the design is modified.

5.5 ENGINEERING FILES CASK FLEET ASSUMPTIONS

The cask fleet for the current reference design has increased beyond the inputs made to the ACD simulation model as follows:

	ACD Canistered		ACD Bare Fuel		VA DESIGN [1] Mostly Bare Fuel	
Transport Method	**Fleet**	**Casks/yr**	**Fleet**	**Casks/yr**	**Fleet**	**Casks/yr**
RAIL	24	72	50	150	131	*393
RAIL DECON (Weeping)		47		41	*Handled in WHB	
TRUCK	12	36	35	105	14	*42
TRUCK DECON (Weeping)		5		27	*Handled in WHB	
ASKS/YEAR		160		323		435
LEET TOTAL	36		85		145	

[1] VA design is the current reference design, presented in the Viability Assessment document (DOE 1998b, Volume II, Section 4.1, pp. 4-1 to 4-38)

Important to the CMF performance is the total number of casks that are handled by the facility per unit time. From the above information, the current (VA) estimate of the cask fleet is increased, and the total number of casks per year (without decontamination due to weeping) is about 35 percent higher than the ACD bare fuel case. It is assumed in this report that the CMF will be required to operate two shifts per day, seven days a week to make up the difference with the ACD Bare Fuel case. In order to accommodate the 'weeping casks' at the same percentage as the ACD, it is assumed that these casks will be handled in the Waste Handling Building (WHB), which is the basis for the VA Design. Estimates for CMF facility manpower have been adjusted to accommodate the 7-day, 2-shift operation.

5.6 KEY CMF FACILITY AND SYSTEM PARAMETERS

This subsection describes key CMF facility and associated system parameters selected as engineering data for the EIS contractor. The data are for the Reference Design, which is the ACD Design as updated herein to include applicable VA Design data (i.e, data is not provided for evaluation cases or alternatives included in previous EIS Engineering File issues). The data are associated with the baseline repository inventory of 70,000 MTHM, which includes commercial spent nuclear fuel (CSNF), vitrified high-level waste (HLW), and DOE spent nuclear fuel (SNF). The Emplacement Operations Phase for the reference design is scheduled to span 24 years.

The CMF design configuration is as defined herein, except as modified by the recent cask fleet estimate and the manpower and shift operations defined in Sections 5.4, Cask Throughput Simulation Results, and 5.5, Engineering Files Cask Fleet Assumptions. Table III-1 is a tabular summary of key facility and system parameters for the Reference Design.

Table III-1. Key Facility and System Parameters (Reference Design)

Facility/System	Parameter
CMF Cask Receiving Systems	
Annual Cask Receipt Rates	
Rail Casks	393
Truck Casks	42
All Types	435
CMF gross floor space (square feet)	116,400
CMF Functional Areas	
Test, Maintenance and Repair Crane	1 @ 200-ton (1)
Test, Maintenance and Repair Area (square feet)	14,800
Cask Preparation and Decontamination Pits	2
Reconfiguration and Basket Storage Pool (Length x Width x Diameter) (2 sections)	69 x 53 x 20 11 x 53 x 41
Trailer and Railcar Cleaning Bay (square feet)	1,900
Clean Shop (square feet)	2,700
Contaminated Shop (square feet)	3,900
Laydown Area (square feet)	8,500
Support Areas (square feet)	84,600
CMF Site-Generated Radioactive Waste Handling System	
Generated Low-Level Waste (LLW) Rates (pre-treatment)	
Recyclable Liquid (gallons per year)	74,300
Non-Recyclable Liquid (gallons per year)	25,800
Solid (cubic feet per year)	28,400
Utility Systems	
Peak Utility Rates	
Well water (gallons per minute)	7
Electric Power (MW)	3.2
Non-radioactive Waste Systems (annual)	
Solid Waste	
Hazardous (cubic feet)	1,400
Sanitary/Industrial (cubic yards)	37
Recyclable (cubic yards)	455
Liquid Waste	
Hazardous (gallons)	4,400
Sewage (thousand gallons)	543

(1) 140 - 150 maximum cask weight per VA design.

Source: CRWMS M&O 1999, p. 14.

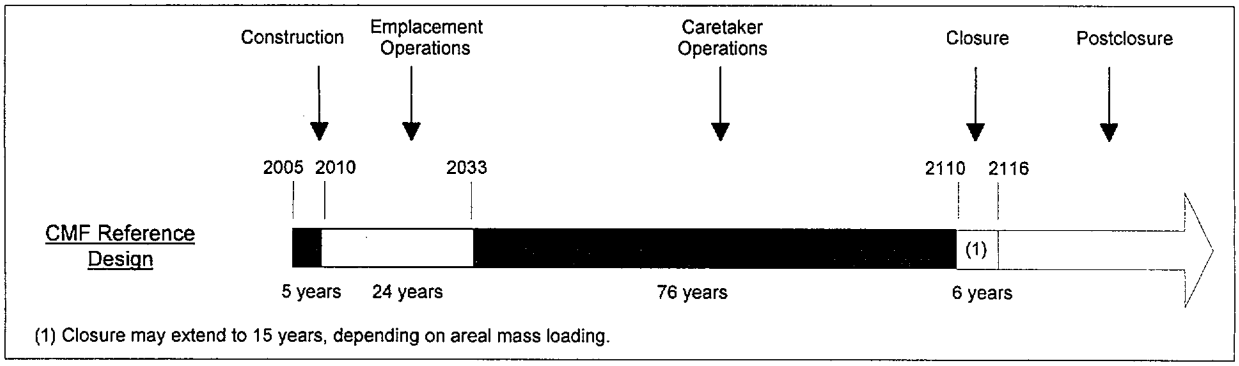


Figure III-2. CMF Reference Design Operational Phases

6. ENVIRONMENTAL DATA

This section includes tabular engineering values, including staffing, wastes, resources and land use for the CMF reference design during construction, emplacement, caretaker, and closure operations. As described in Section 5, the data is primarily influenced by the changes in the size of the shipping cask fleet, and assumptions that the shift operations at the CMF will be expanded without changes to the facility design. Based on the simulation results summarized in Section 5, these assumptions are considered to be conservative. The CMF facility and system parameters in this section are presented for the reference design only. The duration of each phase and the year the phase starts are depicted in Figure III-2.

6.1 CONSTRUCTION

The MGR surface facility Construction Phase is expected to span about five years, beginning in March 2005. Construction activities occur over about 44 months and include site preparation, construction of the CMF, and other nuclear and support facilities, and the initial verification of systems. The staffing, utility and resource usage, emissions, and site-generated waste will peak toward the middle of construction. Following construction, the operations staff will be hired and trained and cold start-up will be completed. Table III-2 contains the CMF engineering values of interest to the EIS contractor for this phase. These data do not include the impacts from start-up.

- Employment - Work years in full-time equivalents (FTEs) expended during CMF construction, broken down by craft workers, construction management and staff and total.

Table III-2. CMF Design Data for Construction

Category	
Employment (Based on 2 years)	
Total for Phase	
Craft Workers	104
Construction Management and Staff	41
Total	145
Materials/Resources (Total for the entire phase unless noted)	
Utilities	
Electricity (MWh)	302
Well Water (1000 gallons)	1,176
Liquid Fuels (gallons)	37,500
Utilities (peak hour)	
Electricity (MW)	0.13
Well Water (gallons/day)	2,000
Solids	
Concrete (cubic yards)	15,350
Gravel (cubic yards)	4,850
Asphalt (cubic yards)	680
Steel (tons)	3,056
Industrial Gases (1000 scf)	105.9
Wastes Generated (Total for the entire phase)	
Solids	
Concrete, Gravel and Asphalt (cubic yards)	420
Steel (tons)	46
Sanitary/Industrial (cubic yards)	290
Recyclable (cubic yards)	726
Hazardous (drums)	208
Liquid	
Sanitary Wastewater (million gals)	0.22
Oils and Lubricants (gallons)	750
Trucks and Buses to and from site	3,406
Land Use	
Construction support area (acres)	2.5

scf = standard cubic feet
MW = megawatt
MWh = megawatt hour
Source: CRWMS M&O 1999, p. 15.

- Materials/Resources - Materials consumed during CMF construction, including utilities, concrete, steel, fuels, and utility consumption.

- Wastes Generated - Total solid and liquid wastes generated during CMF construction, including concrete, steel, trash, wastewater, oils, and lubricants. Steel waste materials will be recycled as scrap before completing construction. No radioactive or mixed wastes are generated during construction.

- Emissions - Air pollutants emitted, including dust (land clearing, site preparation, and other construction activities), exhaust from vehicles during CMF construction, and from vehicles delivering CMF construction materials and workers. The amount of CMF land to be graded during this phase is indicated in the Land Use table. It is expected that the EIS contractor will estimate the construction emissions based on the construction staffing and graded land area.

- Land Use - Site area disturbed during the phase, including the area cleared for CMF construction, laydown area for equipment storage, on-site fabrication for construction, and staging for construction materials.

6.2 EMPLACEMENT OPERATIONS

Emplacement operations will begin approximately in March 2010 and are expected to span about 24 years. Surface emplacement operations include waste receiving, waste preparation, cask maintenance in the CMF, site-generated LLW treatment, and support operations. After the initial ramp up, operations are fairly steady over the emplacement period. CMF operations are planned for two shifts per day, 7 days per week. Table III-3 includes the CMF engineering values of interest to the EIS contractor for this phase, except as noted.

- Employment – annual employment (FTEs) for the CMF.

- Worker Dose - to be determined.

- Utilities - electricity, well water and liquid fuels consumed during a peak emplacement year. Annual consumption and consumption rate during a peak are provided.

- Chemicals - annual consumption of chemicals related primarily to preparation and treatment of water streams. Although only those chemicals consumed in significant quantities are listed, other chemicals will be utilized throughout the facility.

- Wastes Generated - total post treatment solid and liquid wastes generated annually. Included are solid LLW, recyclable waste, solid and liquid mixed waste, hazardous waste, and sewage. LLW is routed to the WTB for processing. Untreated mixed and hazardous wastes are packaged for shipment off-site. Solid sanitary/industrial wastes are sent to an off-site landfill. Recyclable solid wastes are segregated at the point of generation and shipped to off-site commercial recyclers.

- Gaseous Emissions - peak annual air pollutants emitted during the phase including various gases used or generated as a result of the activities conducted at the CMF. Effluent streams are scrubbed and/or filtered to remove or reduce the amount of undesirable particulates before they are released. Radioactive gas emissions result from spent fuel assembly cladding leaks assumed to occur in a small fraction of the fuel assemblies.

- Land Use - site area cleared to construct the CMF.

Table III-3. CMF Design Data for Emplacement Operations

Category	Value
Employment (Full-time equivalents FTEs)	
CMF:	
Administration	20
Operations	57
Maintenance and Supply	14
Total Annual	91
Utilities (Peak)	
Annual	
Electricity (MWh)	20,000
Well Water (million gallons)	3.6
Fuel Oil (thousand gallons)	441
Peak Hour	
Electricity (KW)	3,200
Well Water (gallons per day)	414
Fuel Oil (gallons per hour)	60.9
Chemicals (Annual)	
Solidification Agent (cubic feet)	10,800
Resin (cubic feet)	1,800
NaCl (1000 pounds)	184
$Al_2(SO4)_3$ (1000 pounds)	5.5
Liquid Chemicals (gallons)	
Cleaning Solvents	47
Sodium Hydroxide	13
Oils and Lubricants	200
H_2SO_4 (thousand pounds)	7.3

Table III-3. CMF Design Data for Emplacement Operations, Continued

Category	Value
Gaseous Chemicals (pounds)	
Chlorine	70
Helium	4,800
Nitrogen	12,000,000
Wastes Generated (annual, post treatment)	
Solid Waste	
Low-Level Radioactive (cubic feet)	10,900
Mixed Waste (cubic feet)	2
Hazardous (cubic feet)	700
Sanitary/Industrial (cubic yards)	480
Recyclable cubic yards)	455
Liquid Waste	
Hazardous (gallons)	110
Mixed (gallons)	6
Sewage (thousand gallons)	543
Gaseous Emissions (annual)	
Radioactive (curies)	
Krypton 85	280
Krypton 81	4×10^{-8}
Xenon 127	1.6×10^{-33}
Radon 219	6×10^{-7}
Radon 220	1.8×10^{-3}
Radon 222	2×10^{-8}
PM_{10} (tons)	To Be Provided
Chemical	
Sulfur Dioxide (tons)	1.6
Oxides of Nitrogen (tons)	4.4
VOC (tons)	0.04
Carbon Monoxide (tons)	1.1
TSP (tons)	0
Land Use (Disturbed area in acres)	
Construction support area (acres)	2.5

PM_{10} = particulate matter: 10 microns and smaller
VOC = Volatile Organic Compounds
TSP = Total Suspended Particulates
Source: CRWMS M&O 1999, pp. 16 and 17.

6.3 CARETAKER DECONTAMINATION OPERATIONS

Repository caretaker operations begin after the last waste is emplaced in the Repository and end when the NRC authorizes closure activities. The Caretaker Phase maintains the capability to retrieve the emplaced waste, required for 100 years following the beginning of emplacement. The phase is expected to span about 76 years, beginning in 2034 and ending in 2110. Initial CMF caretaker operations are expected to span about three years and include the decontamination, lock-down, and shutdown and preservation of electrical, mechanical, and hydraulic systems in the facility. The Standby phase during Caretaker will support minor CMF manpower.

Table III-4 contains the CMF engineering values of interest to the EIS contractor, and includes the data listed below for the initial decontamination and facility shutdown period.

- Employment - Total work years (FTEs) expended during facility decontamination and lock-down, including workers, management, and staff.

- Materials/Resources - Materials consumed during the facility decontamination, including utilities, fuels, and solid and liquid chemicals.

- Wastes Generated - Total solid, liquid hazardous, and LLW processed during the decontamination of facilities, including industrial trash and sanitary waste.

6.4 CLOSURE OPERATIONS

The repository Closure Phase begins after the Caretaker Phase, when authorized by the NRC. The phase is expected to span about six years, beginning in 2111 and ending in 2116. CMF closure operations include final decontamination and demolition of the facility (e.g., scalping concrete and removing steel liners and contaminated equipment), dismantlement and removal of the equipment, grading and landscaping to return to a more natural look.

Table III-5 contains the CMF engineering values of interest to the EIS contractor for this phase, including:

- Employment - Work years (FTEs) expended during demolition and site restoration, broken down by craft workers, construction management and staff.

- Materials/Resources - Materials consumed during CMF demolition and site restoration, including utilities, chemicals and gases, concrete and steel, and liquid fuels.

- Wastes Generated - Total solid and liquid, hazardous, non hazardous, and LLW wastes generated by the CMF during the entire phase, including industrial trash and sanitary wastewater. The steel waste materials will be recycled as scrap material, and minimal mixed wastes are expected to be generated.

- Emissions - Air pollutants emitted during the phase, including fugitive dust (from land clearing, site preparation, excavation), exhaust from vehicles, including vehicles delivering or removing materials and workers. It is expected that the EIS contractor will estimate the closure emissions based on the closure staffing and the graded land area.

Table III-4. CMF Design Data for Caretaker Decontamination Operations

Category	Value
Employment (Total for initial decontamination)	
Total work years (FTEs)	68
Materials/Resources (Total for initial decontamination)	
Utilities	
Electricity (MWh)	60,000
Well Water (thousand gallons)	10,800
Liquid Fuels (gallons)	1,323,000
Solid Chemicals	
Solidification Agent (cubic feet)	500
Resin (cubic feet)	95
NaCl (1000 pounds)	0
$Al_2(SO_4)_3$ (pounds)	3,110
Liquid Chemicals (gallons)	
Cleaning Solvents	47
Sodium Hydroxide	31
Oils and Lubricants	470
H_2SO_4 (1000 pounds)	3.3
Gaseous Chemicals (pounds)	
Chlorine	78
Wastes Generated (Total for the initial decontamination and shutdown operations, post treatment)	
Solid Waste	
Low-Level Radioactive (cubic feet)	1,580
Mixed Waste (cubic feet)	2
Hazardous (cubic feet)	3,400
Sanitary/Industrial (cubic yards)	1,150
Recyclable (cubic yards)	820
Liquid Waste	
Hazardous (gallons)	110
Mixed (gallons)	6
Sewage (thousand gallons)	217

MWh= megawatt hour
FTE = full-time equivalent
Source: CRWMS M&O 1999, p. 18.

Table III-5. CMF Design Data for Closure Operations

Category	Value
Employment (Based on 6.0 years)	
Total for Phase	
Craft Workers	62
Construction Management and Staff	23
Total	85
Peak Annual	20
Materials/Resources (Total for the entire phase unless noted)	
Utilities	
Electricity (MWh)	382
Well Water (1000 gallons)	2,455
Liquid Fuels (gallons)	22,400
Utilities (peak hour)	
Electricity (MW)	0.05
Well Water (gallons/day)	2,000
Industrial gases (1000 scf)	63.2
Wastes Generated (Total for the entire phase)	
Solids	
Low-Level Radioactive (cubic feet)	15,733
Concrete, Gravel and Asphalt (cubic yards)	11,052
Steel (tons)	2,017
Sanitary/Industrial (cubic yards)	170
Recyclable (cubic yards)	425
Hazardous (drums)	124
Liquid	
Sanitary Wastewater (million gallons)	0.13
Oils and Lubricants (gallons)	448
Trucks and Buses to and from site	2,027
Land Use	
Construction support area (acres)	2.5

scf = Standard cubic feet

MW = megawatt

MWh = megawatt hour

Source: CRWMS M&O 1999, p. 19.

APPENDIX III-A
List of ACD Figures and Sketches

Figures and sketches listed in this appendix are found in the *Mined Geologic Disposal System Advanced Conceptual Design Report* (ACD) (CRWMS M&O 1996a, Volume II, Appendix D). Page numbers indicated are page numbers within the ACD.

FIGURES

(Figure numbers are as included in the ACD, and are used here for reference)

SKETCHES

<u>Plans, Elevations, and Sections</u>

<u>HVAC Flow Diagrams</u>

Figure List for Attachment IV

Figure Number	Title	Source
1	Site Layout	*Reference Design Description for a Geologic Repository* (CRWMS M&O 1997b)
2	Pre-Repository North Portal Site Plan	*Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998c)
3	Repository Overall Site Plan	*Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998c)
4	North Portal Repository Area Site Plan	*Repository Surface Design Site Layout Analysis* (CRWMS M&O 1998c)
5	Carrier Preparation Building Floor Plan, Elevation and Section	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
6	Waste Handling/Waste Treatment Building Title Figure (Room Legend - General Arrangement Figures)	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
7	Waste Handling/Waste Treatment Building Floor Plan at El. 50+0	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
8	Waste Handling/Waste Treatment Building Floor Plan at El. 85+0	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
9	Waste Handling/Waste Treatment Building Floor Plan at El. 100+0 – Ground Level	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
10	Waste Handling/Waste Treatment Building Floor Plan at El. 124+0	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
11	Waste Handling/Waste Treatment Building Floor Plan at El. 142+0	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
12	Waste Handling/Waste Treatment Building Floor Plan at El. 164+0	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
13	Waste Handling/Waste Treatment Building Building Sections	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
14	Waste Handling/Waste Treatment Building Cross-sectional Building Section	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)

EIS Related Information

Figure Number	Title	Source
15	Waste Handling/Waste Treatment Building Elevations	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
16	Waste Handling/Waste Treatment Building Elevations	*Surface Nuclear Facilities Space Program Analysis* (CRWMS M&O 1997l)
17	WHB HVAC Flow Diagram Composite Key	*Surface Nuclear Facilities HVAC Analysis* (CRWMS M&O 1997m)
18	WHB HVAC Flow Diagram Composite Key	*Surface Nuclear Facilities HVAC Analysis* (CRWMS M&O 1997m)
19	Mechanical Flow Diagram (MFD) - Waste Handling Overview	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
20	MFD - Carrier/Cask Transport System	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
21	MFD - CPB Material Handling System	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
22	MFD - Carrier/Cask Handling System	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
23	MFD - Assembly Transfer System (Assembly Cask Unloading)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
24	MFD - Assembly Transfer System (DPC Unloading)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
25	MFD - Assembly Transfer System (Empty Cask Shipping)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
26	MFD - Assembly Transfer System (Empty DPC Shipping)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
27	MFD - Assembly Transfer System (Staging and Loading)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
28	MFD - Canister Transfer System (Large Canister)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
29	MFD - Canister Transfer System (Small Canister)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)

EIS Related Information

Figure Number	Title	Source
30	MFD - Empty DC Preparation	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
31	MFD - Empty DC Transfer	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
32	MFD - DC Handling System (Welding and Staging)	*Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
33	MFD - DC Handling System (WP Transfer)	Modified from *Mechanical Flow Diagrams (MFDs) for the Waste Handling Systems* (CRWMS M&O 1997o)
34	Recyclable Liquid LLW Treatment	*Secondary Waste Treatment Analysis* (CRWMS M&O 1997i)
35	Chemical Liquid LLW Treatment	*Secondary Waste Treatment Analysis* (CRWMS M&O 1997i)
36	Solid LLW Treatment	*Secondary Waste Treatment Analysis* (CRWMS M&O 1997i)
37	Site Communications	Modified from *MGDS Advanced Conceptual Design Report (ACD)* (CRWMS M&O 1996a)

1

Site Layout

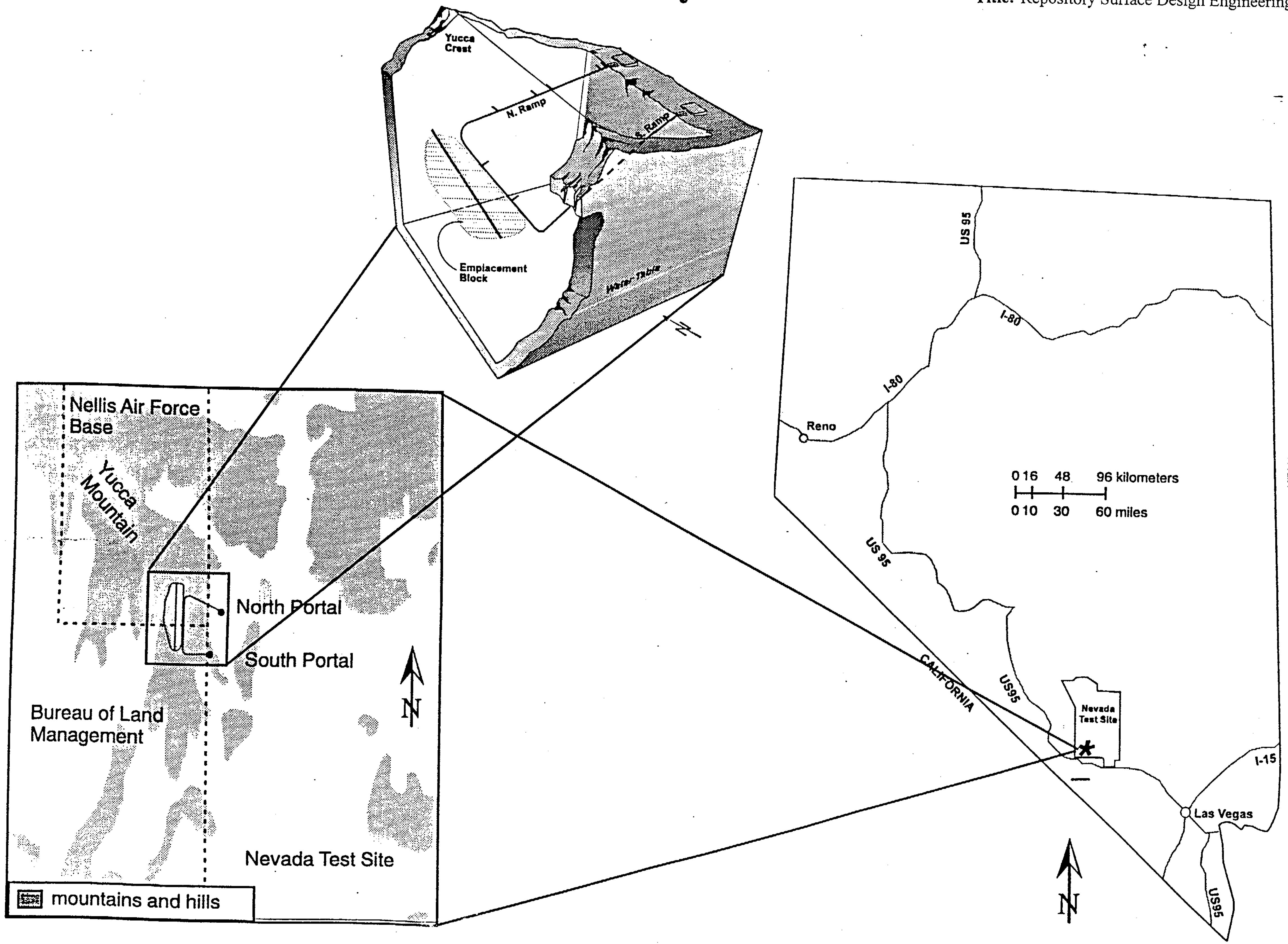
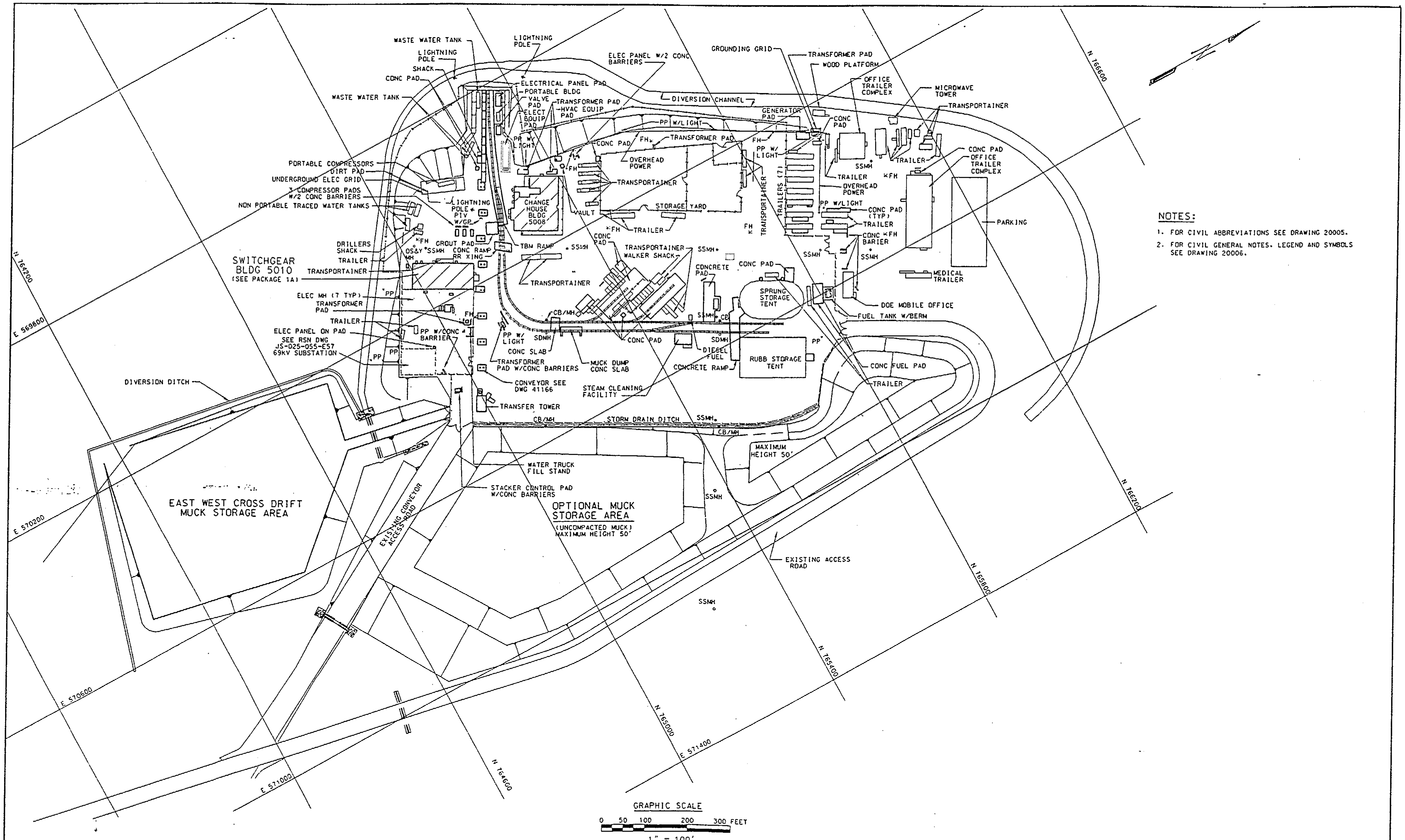


FIGURE 1

MGDSCOC.P65.121.RDD/6-3-97



NOTES:

1. FOR CIVIL ABBREVIATIONS SEE DRAWING 20005.
2. FOR CIVIL GENERAL NOTES, LEGEND AND SYMBOLS SEE DRAWING 20006.

FIGURE 2
PRE- REPOSITORY NORTH PORTAL
SITE PLAN

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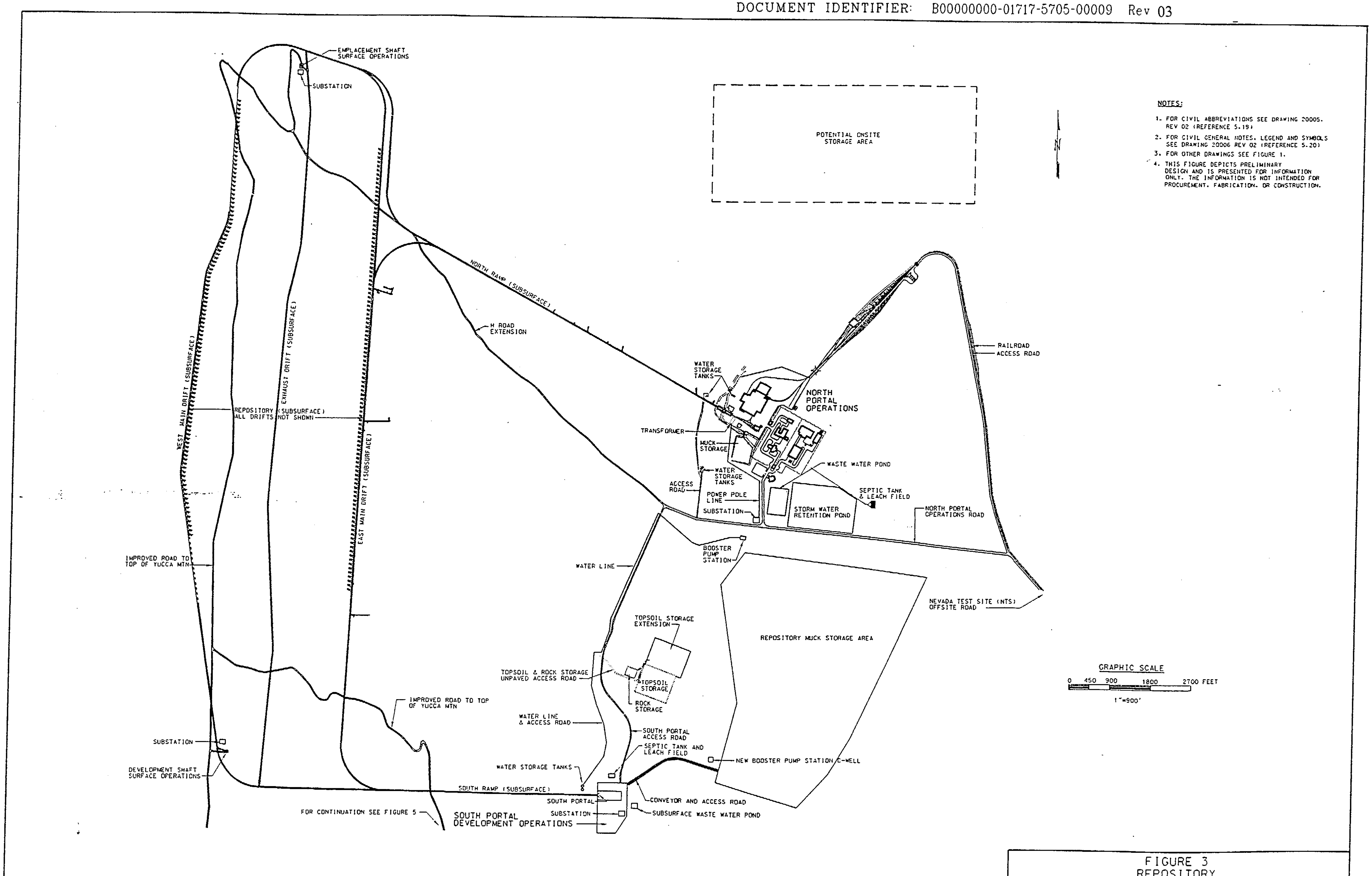
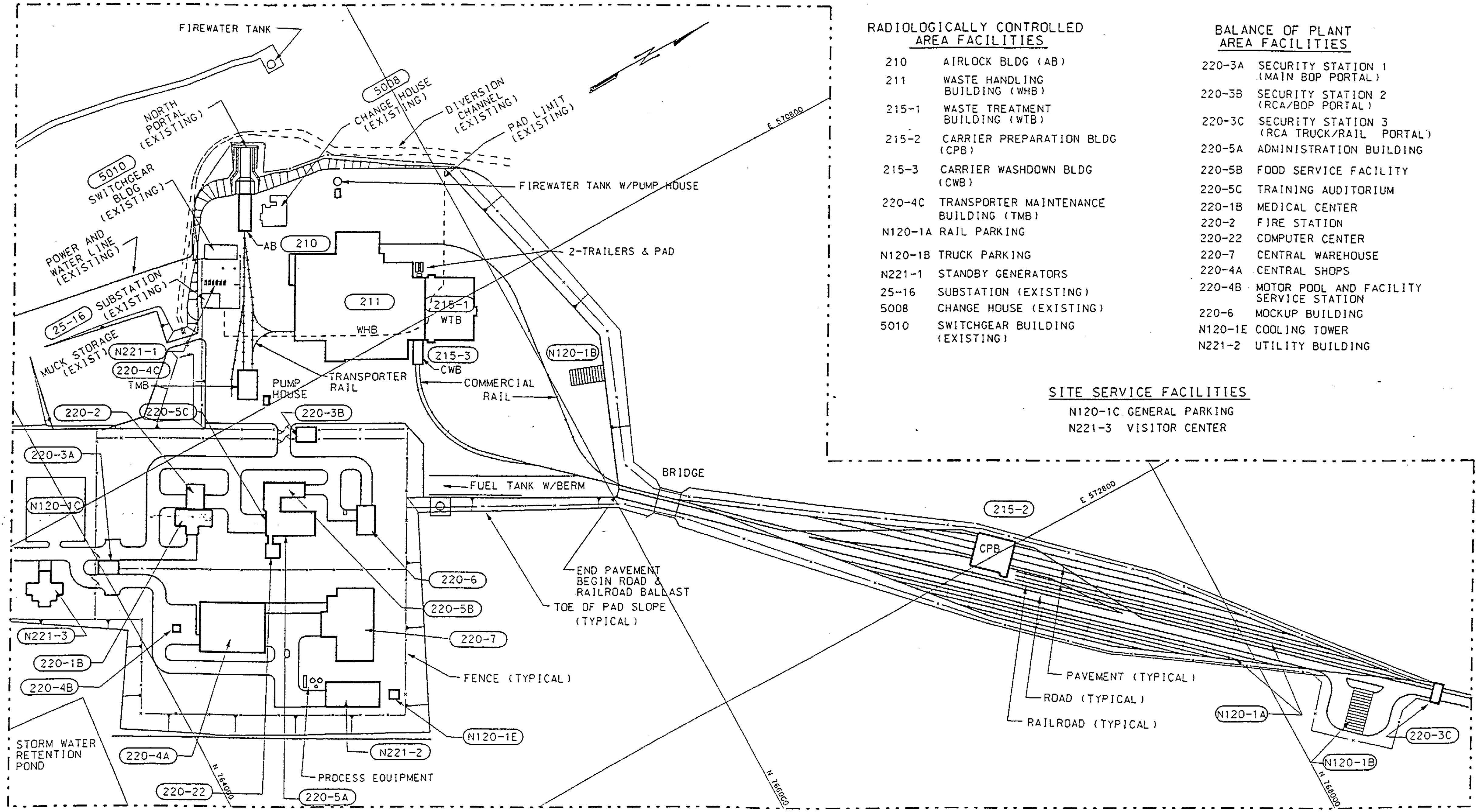


FIGURE 3
REPOSITORY
OVERALL SITE PLAN



RADIOLOGICALLY CONTROLLED AREA FACILITIES

210	AIRLOCK BLDG (AB)
211	WASTE HANDLING BUILDING (WHB)
215-1	WASTE TREATMENT BUILDING (WTB)
215-2	CARRIER PREPARATION BLDG (CPB)
215-3	CARRIER WASHDOWN BLDG (CWB)
220-4C	TRANSPORTER MAINTENANCE BUILDING (TMB)
N120-1A	RAIL PARKING
N120-1B	TRUCK PARKING
N221-1	STANDBY GENERATORS
25-16	SUBSTATION (EXISTING)
5008	CHANGE HOUSE (EXISTING)
5010	SWITCHGEAR BUILDING (EXISTING)

BALANCE OF PLANT AREA FACILITIES

220-3A	SECURITY STATION 1 (MAIN BOP PORTAL)
220-3B	SECURITY STATION 2 (RCA/BOP PORTAL)
220-3C	SECURITY STATION 3 (RCA TRUCK/RAIL PORTAL)
220-5A	ADMINISTRATION BUILDING
220-5B	FOOD SERVICE FACILITY
220-5C	TRAINING AUDITORIUM
220-1B	MEDICAL CENTER
220-2	FIRE STATION
220-22	COMPUTER CENTER
220-7	CENTRAL WAREHOUSE
220-4A	CENTRAL SHOPS
220-4B	MOTOR POOL AND FACILITY SERVICE STATION
220-6	MOCKUP BUILDING
N120-1E	COOLING TOWER
N221-2	UTILITY BUILDING

SITE SERVICE FACILITIES

N120-1C	GENERAL PARKING
N221-3	VISITOR CENTER

NOTES:

1. FOR CIVIL ABBREVIATIONS SEE DRAWING 20005 REV 02 (REF 5.19)
2. FOR CIVIL GENERAL NOTES, LEGEND AND SYMBOLS SEE DRAWING 20006 REV 02 (REF 5.20)
3. FOR OTHER FIGURES SEE FIGURE 1.
4. THIS FIGURE DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION

GRAPHIC SCALE

0 100 200 400 600 FEET

1" = 200'

FIGURE 4
NORTH PORTAL REPOSITORY AREA SITE PLAN

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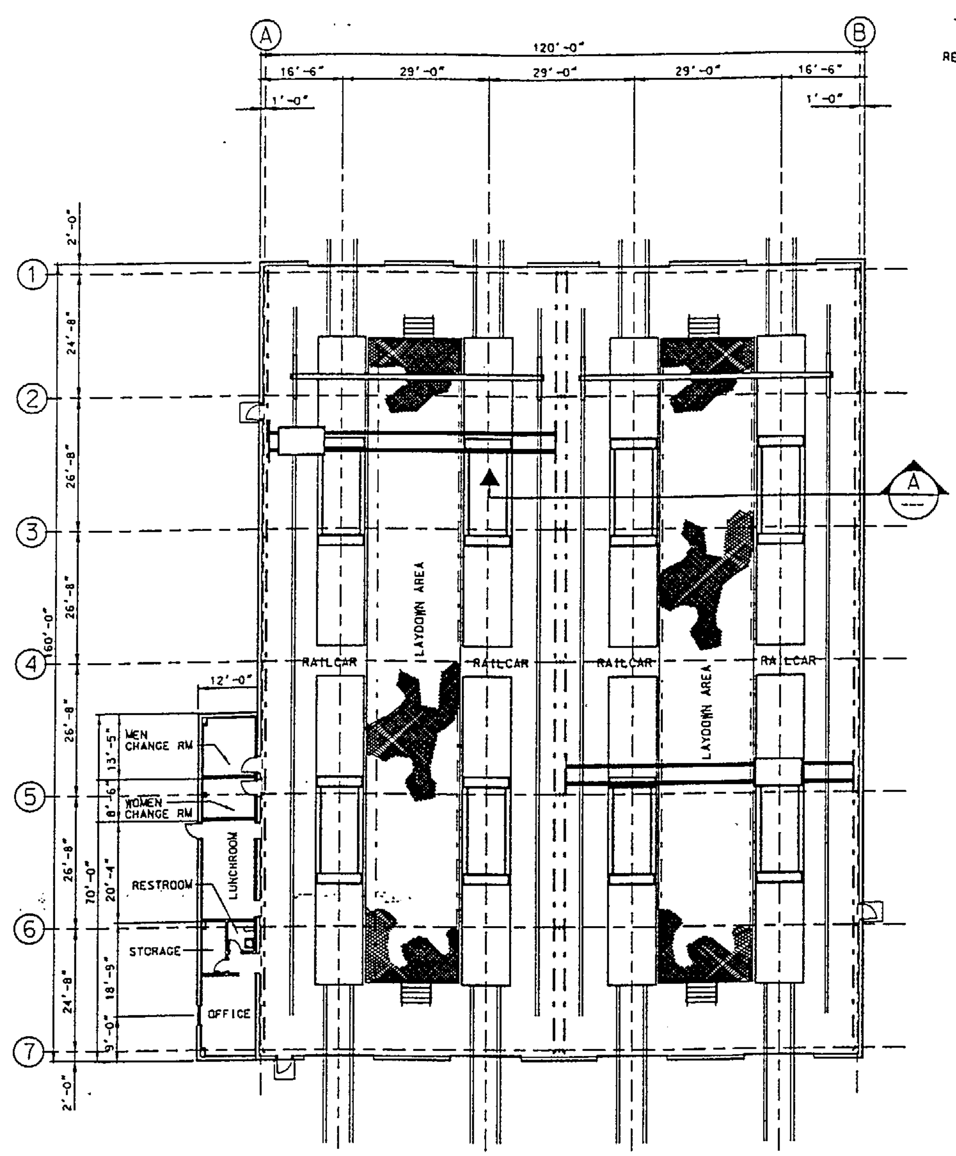
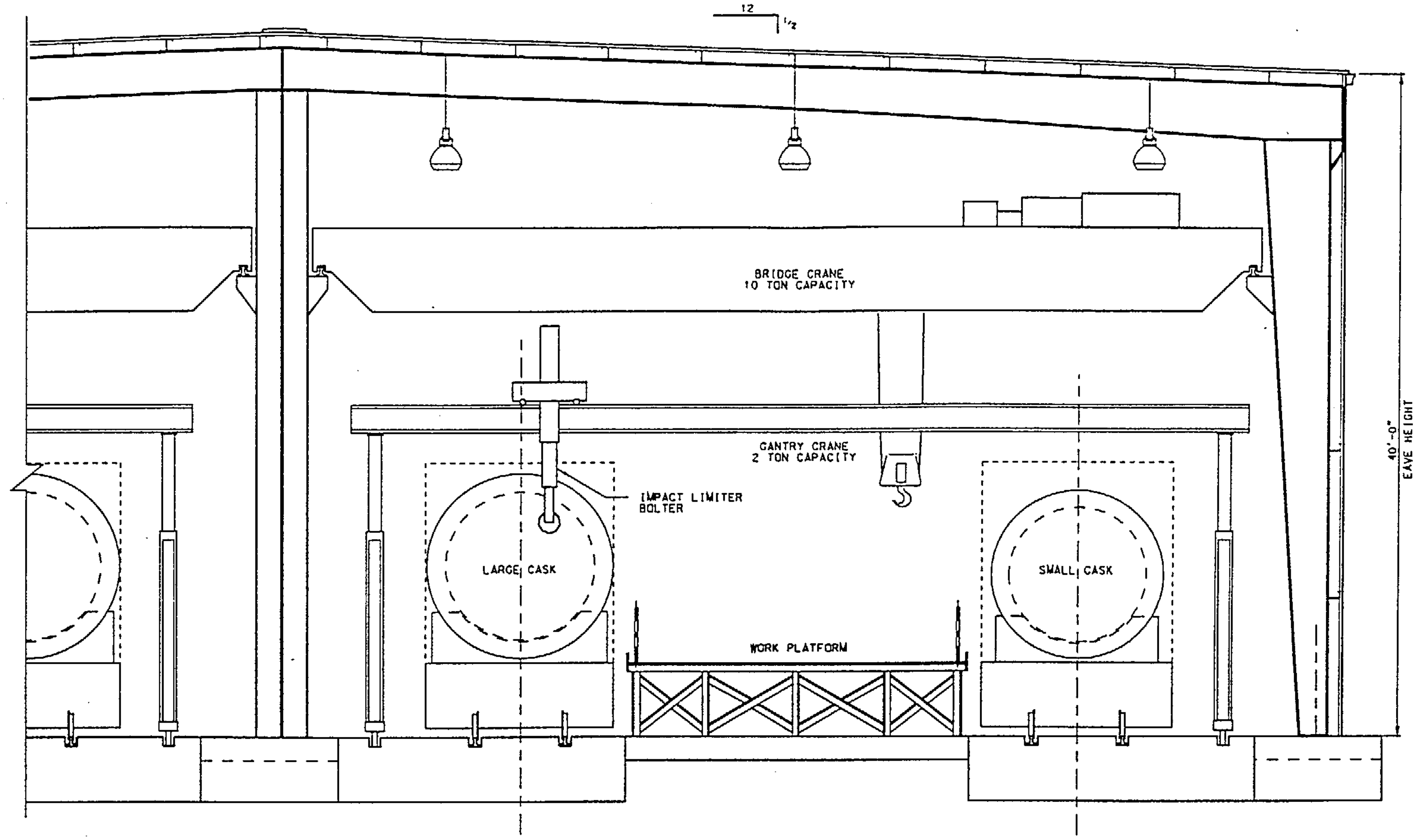
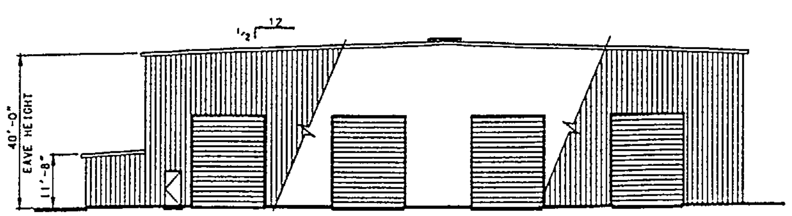


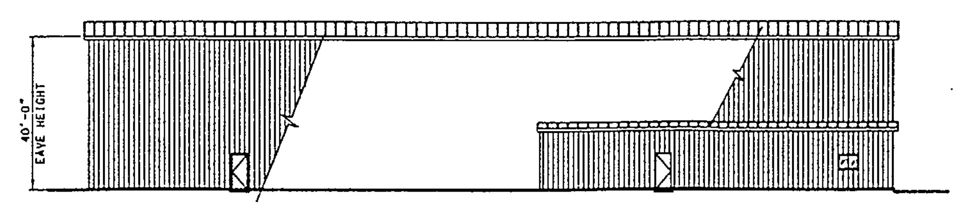
FLOOR PLAN
SCALE: 1/16"=1'-0"



BUILDING SECTION
SCALE: 1/4"=1'-0"



EAST ELEVATION
SCALE: 1/16"=1'-0"



SOUTH ELEVATION
SCALE: 1/16"=1'-0"

GRAPHIC SCALE
0 8 16 24 32 40 48 FEET
1/16" = 1'-0"

FIGURE 5

CARRIER PREPARATION BUILDING
FLOOR PLAN, ELEVATION & SECTION

CRWMS SURFACE NUCLEAR FACILITIES
GENERAL ARRANGEMENT FIGURES

FIGURE LIST

FIGURE	TITLE
1	TITLE FIGURE
WASTE HANDLING/WASTE TREATMENT BUILDING	
2	FLOOR PLAN AT EL. 50+0
3	FLOOR PLAN AT EL. 85+0
4	FLOOR PLAN AT EL. 100+0 - GROUND LEVEL
5	FLOOR PLAN AT EL. 124+0
6	FLOOR PLAN AT EL. 142+0
7	FLOOR PLAN AT EL. 164+0
8	BUILDING SECTIONS
9	CROSS-SECTIONAL BUILDING SECTION
10	ELEVATIONS
11	ELEVATIONS
12	ROOF PLAN
CARRIER PREPARATION BUILDING	
13	FLOOR PLAN, ELEVATION, & SECTION

ROOM LEGEND

WASTE HANDLING BUILDING

PRIMARY AREAS

CARRIER CASK HANDLING SYSTEM
H-100 CARRIER BAY

ASSEMBLY TRANSFER SYSTEM
H-101 (A,B,C) AIRLOCK
H-102 (A,B,C) CASK PREPARATION AND DECONTAMINATION
H-103 (A,B,C) POOL AREA
H-105 (A,B,C) DC LOAD
H-106 (A,B,C) DC DECONTAMINATION
H-205 (A,B,C) ASSEMBLY HANDLING CELL
H-206 (A,B,C) CRANE MAINTENANCE BAY
H-401 (A,B,C) CRANE MAINTENANCE BAY

CANISTER TRANSFER SYSTEM
H-107 (A,B) AIRLOCK
H-108 (A,B) CASK PREPARATION AND DECONTAMINATION CELL
H-109 (A,B) CANISTER TRANSFER CELL
H-209 (A,B) CRANE MAINTENANCE BAY

DISPOSAL CONTAINER HANDLING SYSTEM
H-110 DC HANDLING CELL
H-111 DC TRANSPORTER LOADING CELL
H-112 DC TRANSPORTER AIRLOCK
H-113 LOADED DC STAGING
H-115 AIRLOCK
H-117 EMPTY DC PREPARATION
H-203 WELDER MAINTENANCE BAY
H-208 (A-H) WELDER AIRLOCK
H-301 CRANE MAINTENANCE BAY

WASTE PACKAGE REMEDIATION SYSTEM
H-114 WASTE PACKAGE REMEDIATION CELL AND DECONTAMINATION CELL

PRIMARY SUPPORT AREAS

H-116 CONTAMINATED EQUIPMENT DECONTAMINATION ROOM
H-118 (A,B,C,D,E,F) OPERATING GALLERIES
H-119 WASTE HANDLING OPERATION CENTER
H-120 CONTAMINATED EQUIPMENT AND STAGING
H-121 WELDER MATERIAL STORAGE
H-122 MAINTENANCE EQUIPMENT STORAGE
H-123 TOOL STORAGE
H-124 MAINTENANCE SHOP
H-125 LLW COLLECTION & PACKAGING
H-126 FORKLIFT STAGING AND SERVICING
H-207 (A-J) OPERATING GALLERIES
H-402 ASSEMBLY AND CANISTER TRANSFER SYSTEM
H-403 DC HANDLING AND WP REMEDIATION TRANSFER SYSTEM

POOL SUPPORT AREAS

H-020 POOL TREATMENT EQUIPMENT ROOM

FACILITY SUPPORT AREAS

RADIATION PROTECTION
H-010 REGULATED CHANGE ROOM
H-011 RADIATION PROTECTION PORTAL
H-012 PERSONNEL DECONTAMINATION ROOM
H-013 PERSONNEL RADIATION PROTECTION EQUIPMENT STORAGE
H-014 HEALTH PHYSICS OFFICE
H-015 (A,B) PROTECTIVE CLOTHING/STORAGE
H-129 CALIBRATION SHOP

SECURITY
H-130 (A,B) SECURITY PORTALS
H-131 SECURITY ALARM STATION
H-132 (A,B) OFFICES

OPERATIONS
H-133 (A,B) HEALTH PHYSICS LABORATORIES
H-134 (A,B,C,D) LABORATORY TECHNICIAN OFFICES
H-135 LABORATORY MATERIAL STORAGE
H-136 FIRST AID ROOM/OFFICE
H-016 (A,B) CHANGE ROOM
H-017 (A,B) COVERALL STORAGE
H-137 OPERATIONS LUNCHROOM
H-138 JANITOR CLOSET

ADMINISTRATIVE
H-139 ENTRY LOBBY
H-140 (A,B) SUPERVISOR OFFICE
H-018 (A,B) SUPERVISOR OFFICE
H-141 PLANT OPERATIONS MANAGER OFFICE
H-142 (A,B) QA/QC OPERATIONS OFFICE
H-143 (A,B,C,D) OPERATIONS STAFF OFFICES
H-144 STAFF SUPPORT-OPEN OFFICE
H-145 (A,B) SECRETARIAL OFFICES
H-146 (A,B) DOE MANAGER OFFICE
H-147 (A,B,C,D) DOE STAFF OFFICES
H-148 DOE STAFF SUPPORT-SECRETARIAL
H-149 DOE STAFF SUPPORT-CLERICAL
H-150 CONFERENCE ROOM
H-151 DOCUMENT CONTROL
H-152 COPY ROOM
H-153 STORAGE ROOM
H-154 (A,B) RESTROOMS
H-155 LUNCHROOM
H-156 JANITOR CLOSET

MAINTENANCE
H-019 EQUIPMENT MAINTENANCE SHOP
H-020 INSTRUMENT MAINTENANCE SHOP
H-157 NOT USED
H-158 NOT USED
H-159 TOOL STORAGE
H-160 MAINTENANCE MATERIAL STORAGE
H-161 (A,B) HEPA FILTER STORAGE
H-162 JANITOR CLOSET
H-163 SHIPPING/RECEIVING
H-164 WASTE STAGING
H-165 GAS BOTTLE STORAGE

HVAC EQUIPMENT AREAS

H-166 EMERGENCY EXHAUST
H-171 TERTIARY CONFINEMENT EXHAUST
H-200 OUTSIDE AIR INTAKE (COLD SUPPORT)
H-201 TERTIARY CONFINEMENT EXHAUST
H-202 STACK MONITOR EQUIPMENT
H-204 CARRIER BAY AIR INTAKE
H-300 OUTSIDE AIR INTAKE
H-400 SECONDARY CONFINEMENT EXHAUST

BUILDING SUPPORT AREAS

FIRE PROTECTION
H-167 (A,B) FIRE RISER

ELECTRICAL
H-168 ELECTRICAL DISTRIBUTION
H-169 EMERGENCY GENERATORS

COMMUNICATIONS
H-170 COMMUNICATION ROOM

WASTE TREATMENT BUILDING

PROCESS AREA

T-101 SOLID LLW PROCESSING
T-102 CHEMICAL LIQUID LLW PROCESSING
T-103 RECYCLABLE LIQUID LLW PROCESSING
T-104 MIXED & HAZARDOUS WASTE STAGING

FACILITY SUPPORT AREA

SECURITY
T-105 SECURITY PORTAL
T-106 SECURITY PORTAL
T-107 OFFICE

OPERATIONS
T-108 PARTS STORAGE
T-109 MEN'S CHANGE ROOM
T-110 WOMEN'S CHANGE ROOM
T-111 COVERALL STORAGE
T-112 LUNCHROOM
T-113 (A,B) JANITOR CLOSET
T-114 FORKLIFT STAGING
T-115 SHIPPING/RECEIVING

ADMINISTRATION
T-116 NOT USED
T-117 SUPERVISOR OFFICE
T-118 SUPERVISOR OFFICE
T-119 PLANT MANAGER OFFICE
T-120 PLANT MANAGEMENT SUPERVISOR OFFICE
T-121 STAFF SUPPORT-OPEN OFFICE
T-122 HEALTH PHYSICS OFFICE
T-123 QA OFFICE
T-124 INVENTORY CONTROL OFFICE
T-125 COPY/STORAGE ROOM
T-126 INSTRUMENT CALIBRATION

HVAC EQUIPMENT AREAS

T-200 HVAC OFFICE
T-201 PROCESS AREA SUPPLY
T-202 PROCESS AREA EXHAUST

BUILDING SUPPORT AREAS

FIRE PROTECTION
T-127 FIRE RISER ROOM

ELECTRICAL
T-203 ELECTRICAL POWER DISTRIBUTION
T-204 ELECTRICAL SWITCHGEAR

COMMUNICATIONS
T-128 COMMUNICATION ROOM

FIGURE 6

NOTE:

THESE GENERAL ARRANGEMENT FIGURES ARE PRELIMINARY AND ARE NOT TO BE USED IN SUPPORT OF PROCUREMENT, FABRICATION, OR CONSTRUCTION.

WASTE HANDLING/WASTE TREATMENT BUILDING
TITLE FIGURE

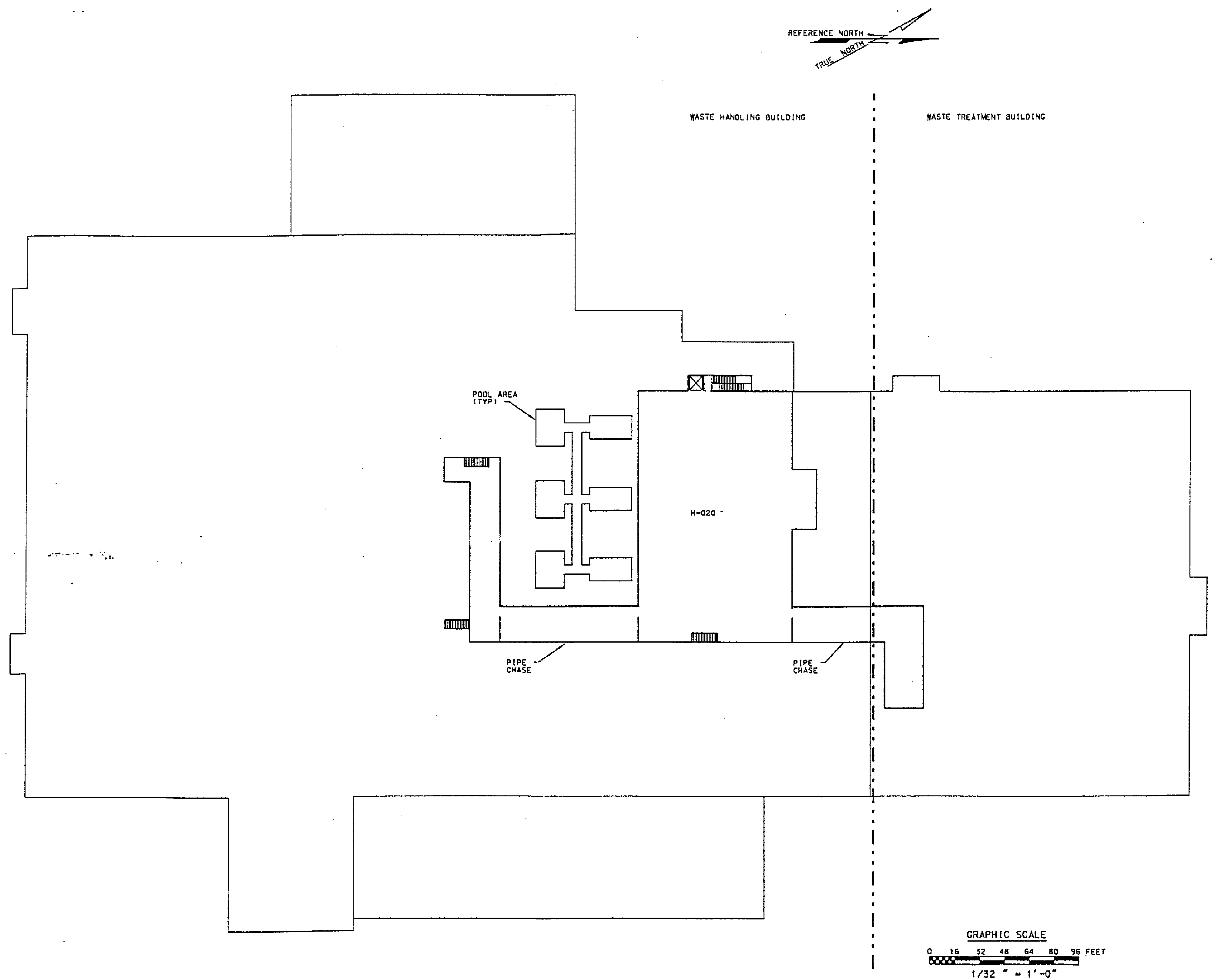


FIGURE 7

WASTE HANDLING/WASTE TREATMENT BUILDING
FLOOR PLAN AT EL. 50+0

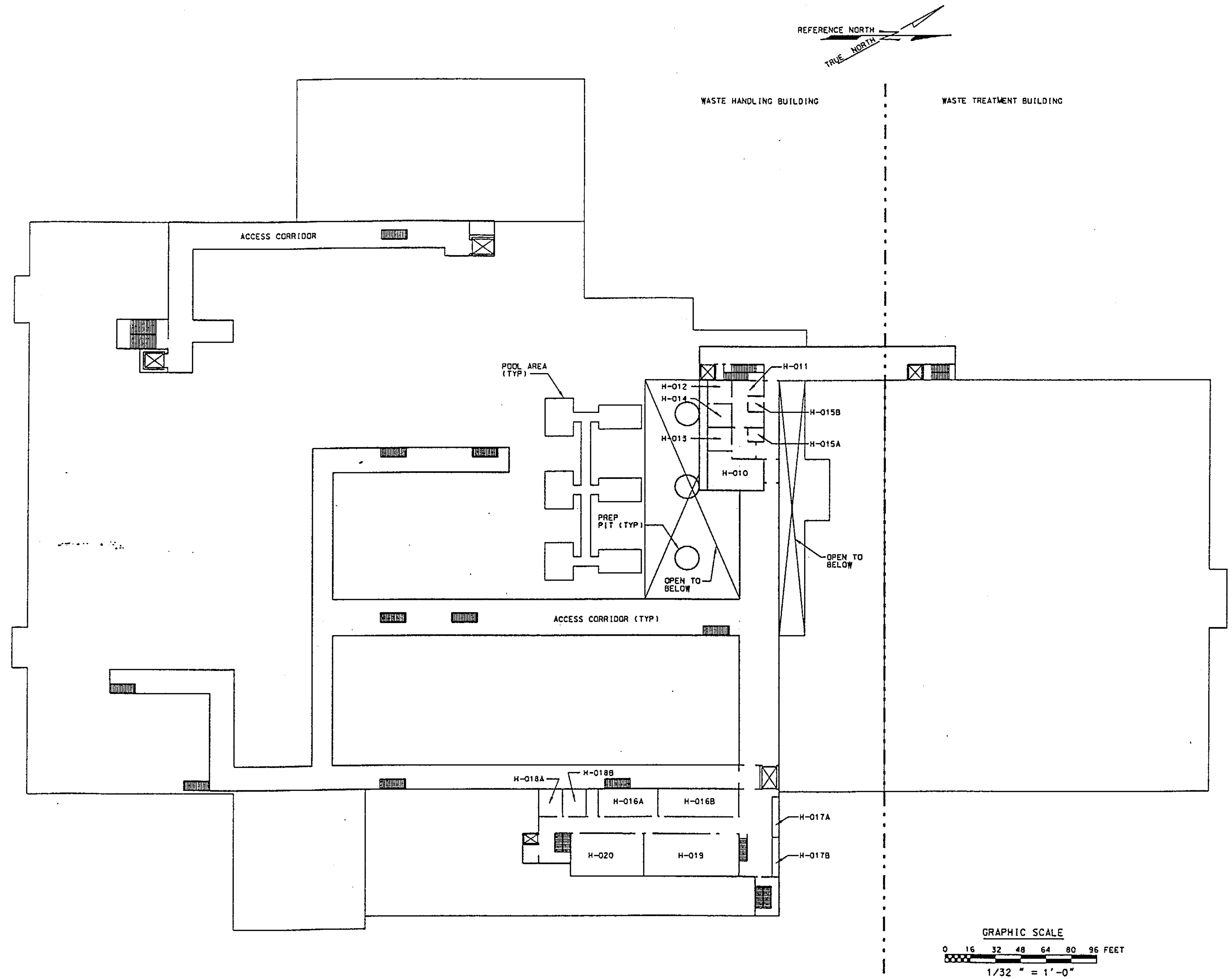


FIGURE 8

WASTE HANDLING/WASTE TREATMENT BUILDING
FLOOR PLAN AT EL. 85+0

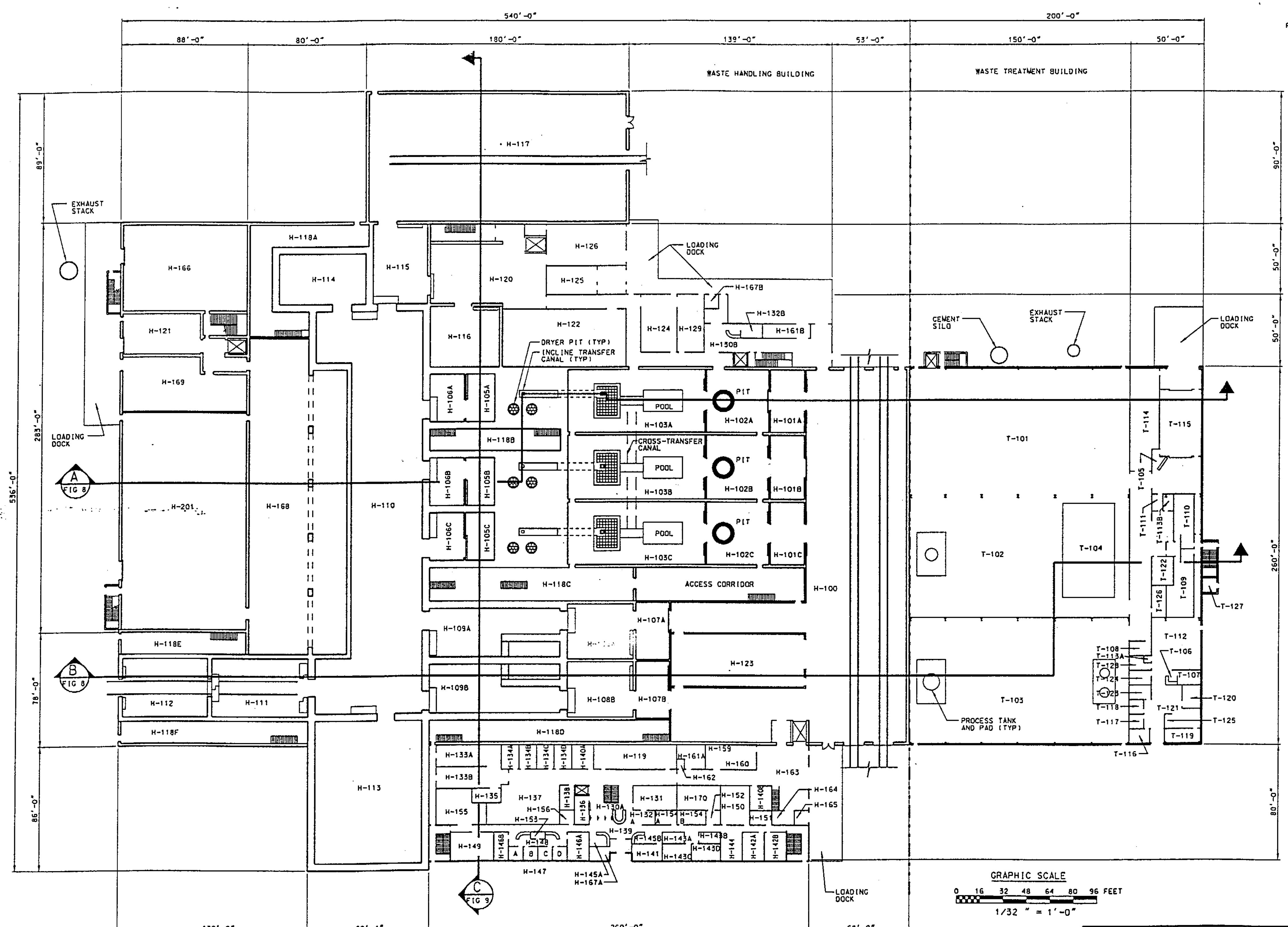


FIGURE 9

WASTE HANDLING/WASTE TREATMENT BUILDING
FLOOR PLAN AT EL. 100+0 - GROUND LEVEL

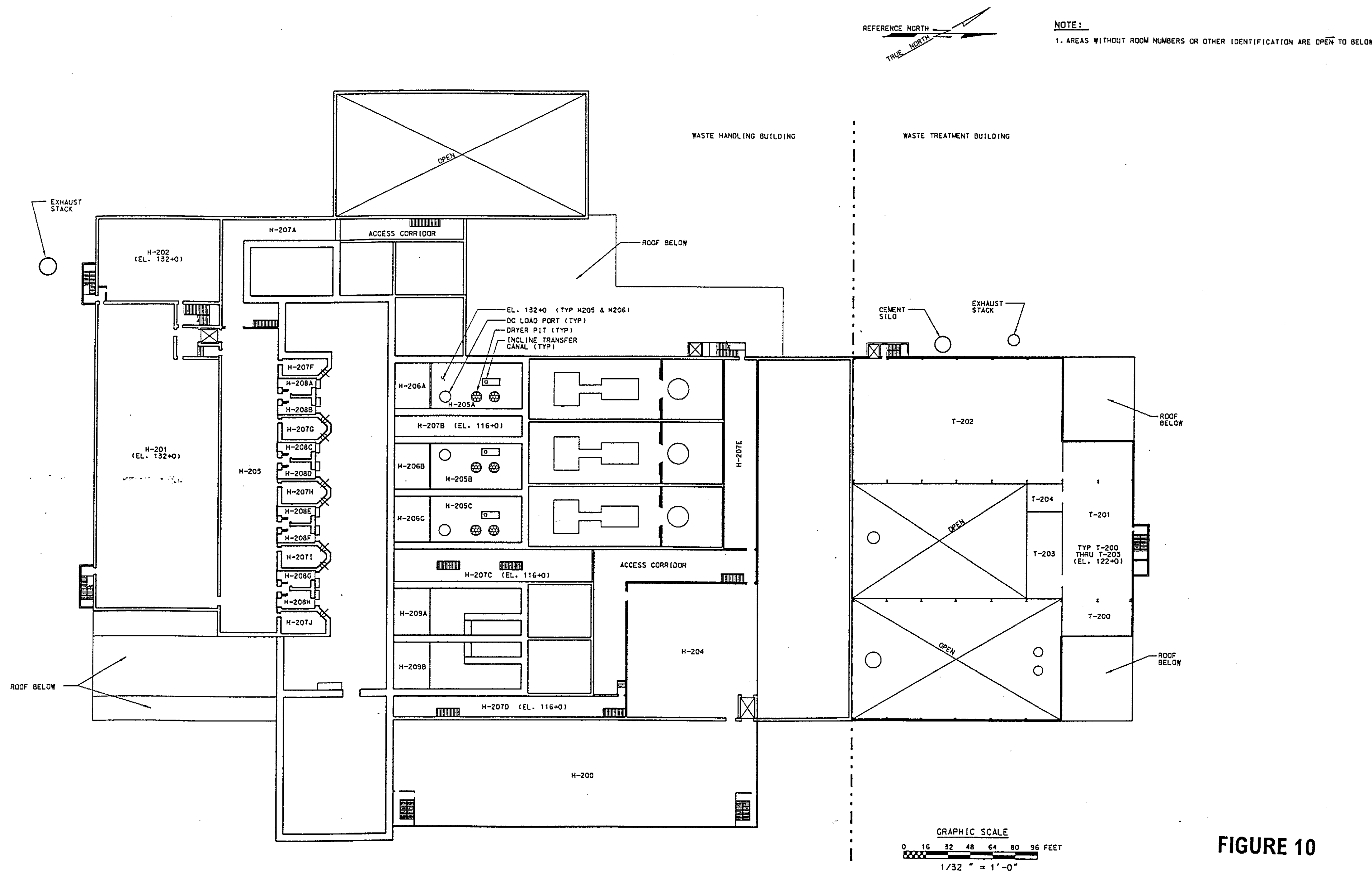


FIGURE 10

WASTE HANDLING/WASTE TREATMENT BUILDING
FLOOR PLAN AT EL. 124+0

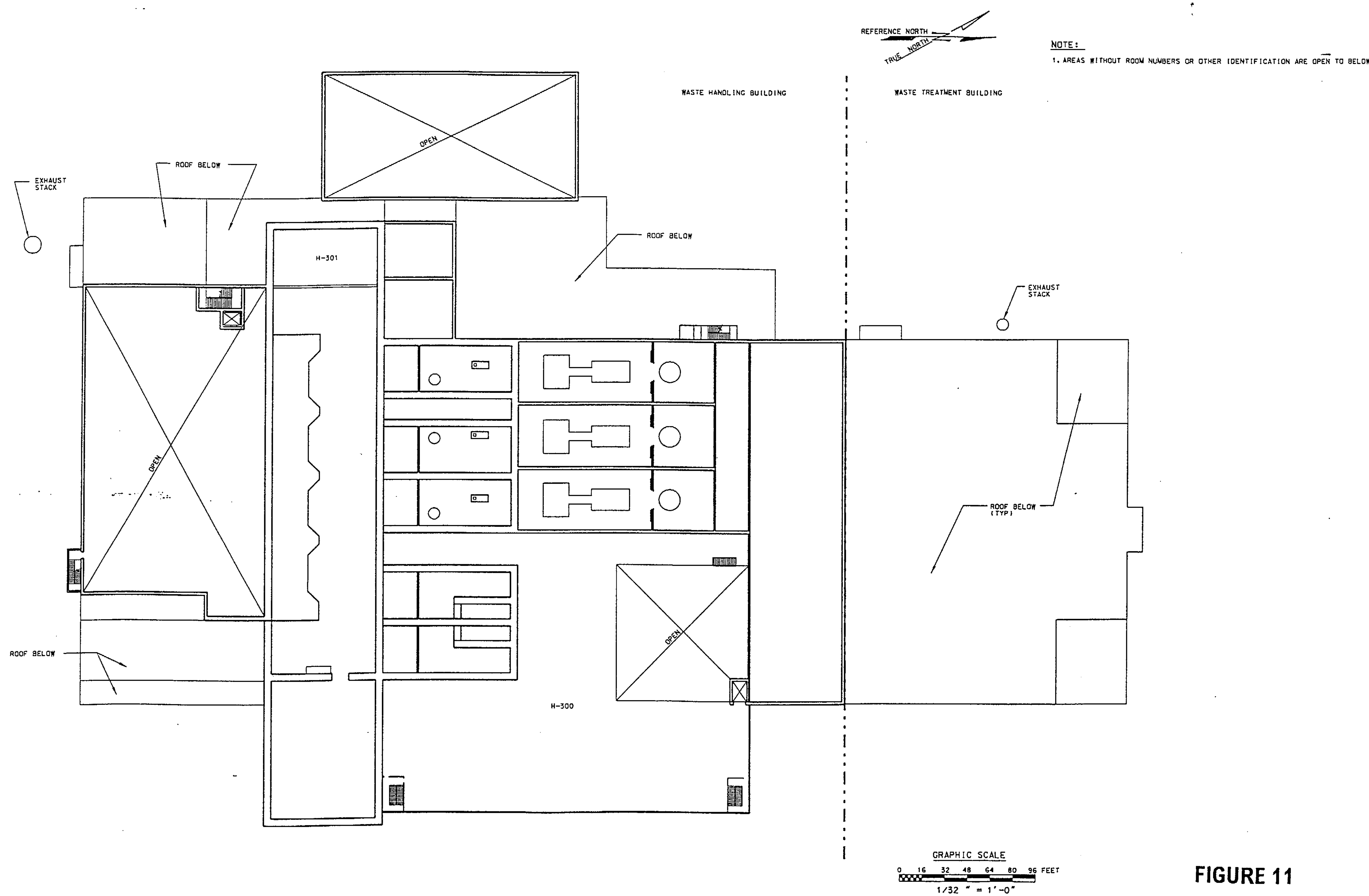


FIGURE 11

WASTE HANDLING/WASTE TREATMENT BUILDING
FLOOR PLAN AT EL. 142+0

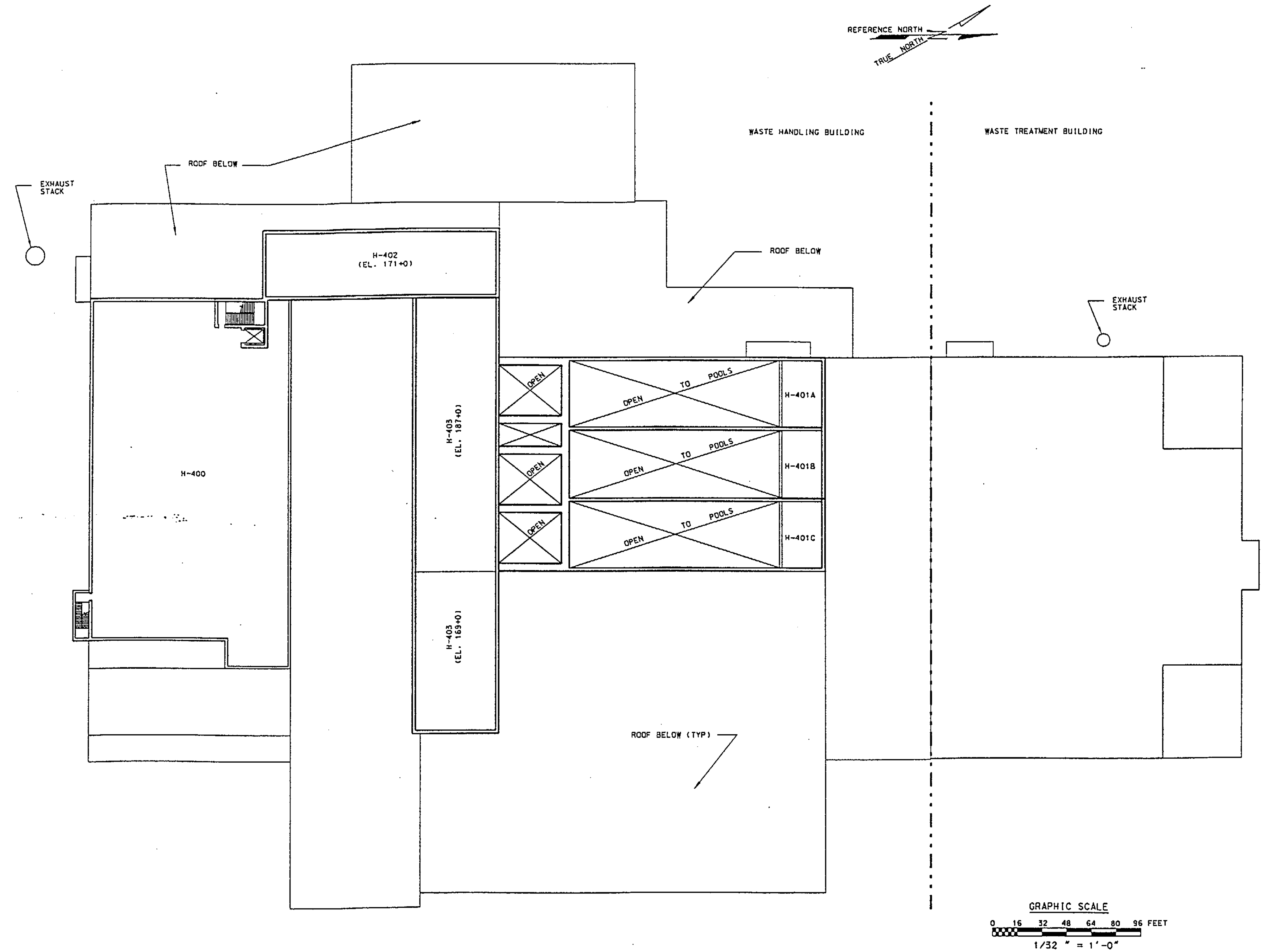
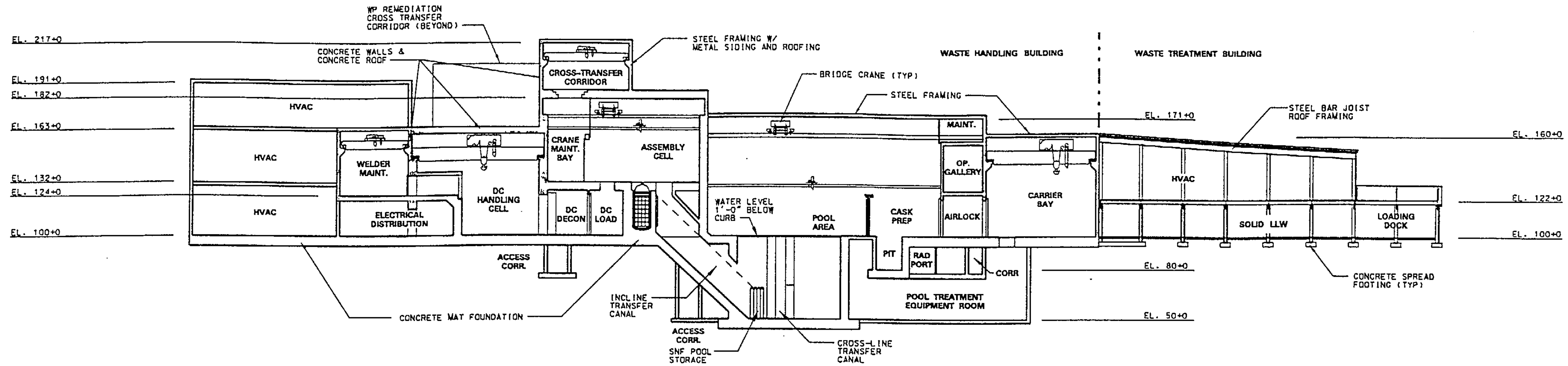


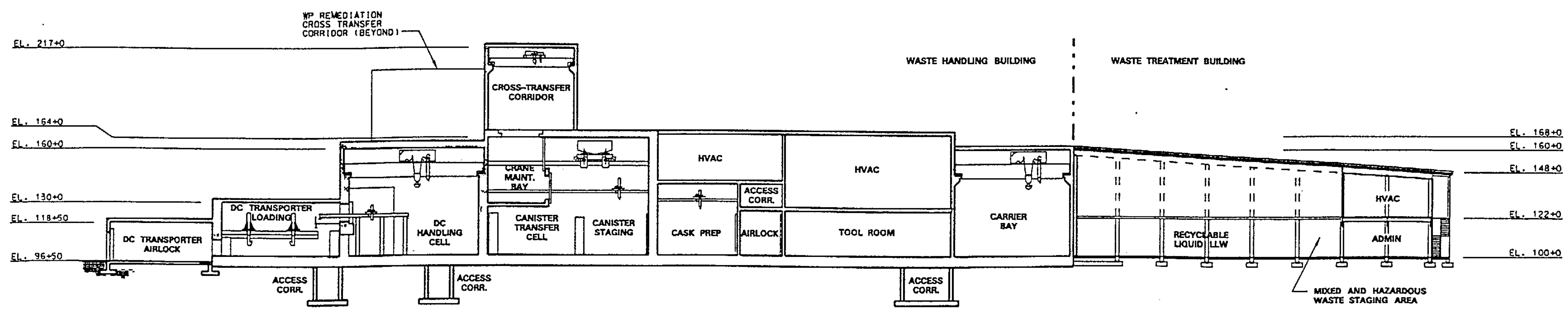
FIGURE 12

WASTE HANDLING/WASTE TREATMENT BUILDING
FLOOR PLAN AT EL. 164+0



BUILDING SECTION - ASSEMBLY TRANSFER

A
FIG 4



BUILDING SECTION - CANISTER TRANSFER

B
FIG 4

GRAPHIC SCALE

0 16 32 48 64 80 96 FEET

1/32" = 1'-0"

FIGURE 13

WASTE HANDLING/WASTE TREATMENT BUILDING
BUILDING SECTIONS

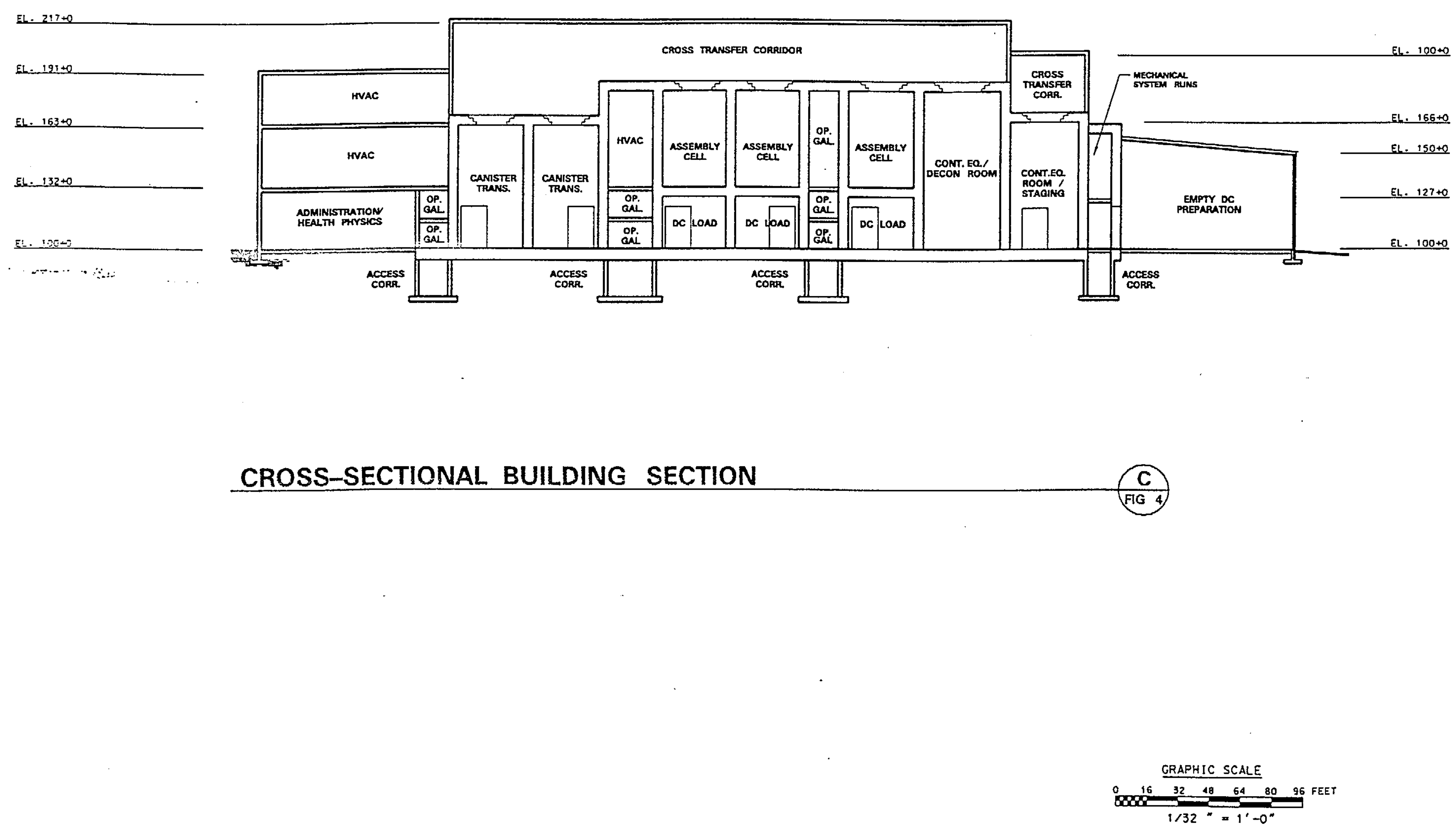
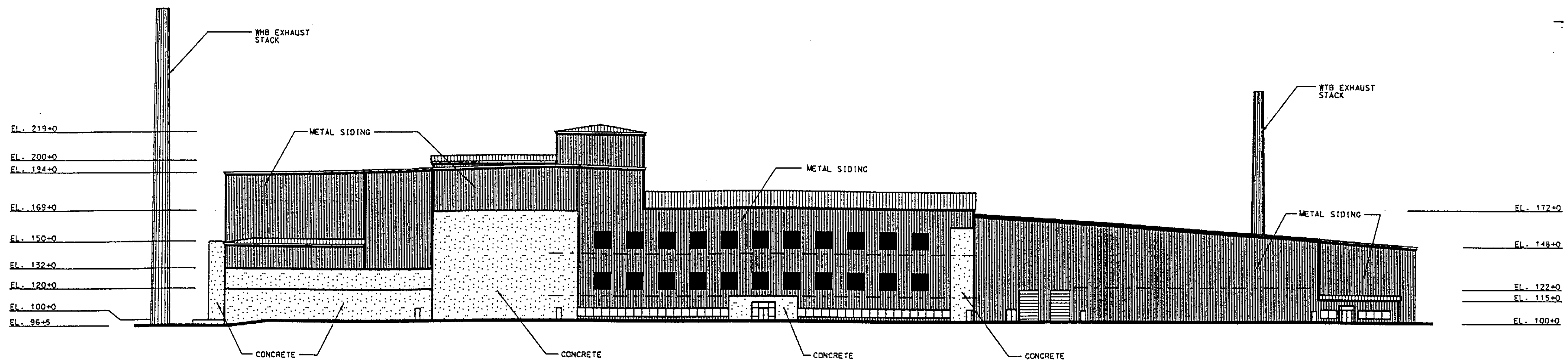
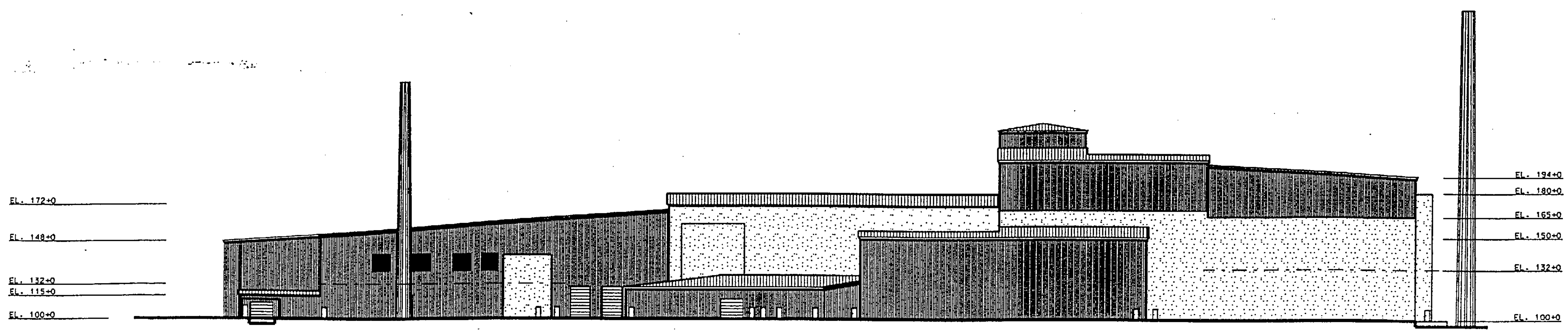


FIGURE 14

WASTE HANDLING/WASTE TREATMENT BUILDING
CROSS-SECTIONAL BUILDING SECTION



SOUTH ELEVATION
SCALE: 1/32"=1'-0"

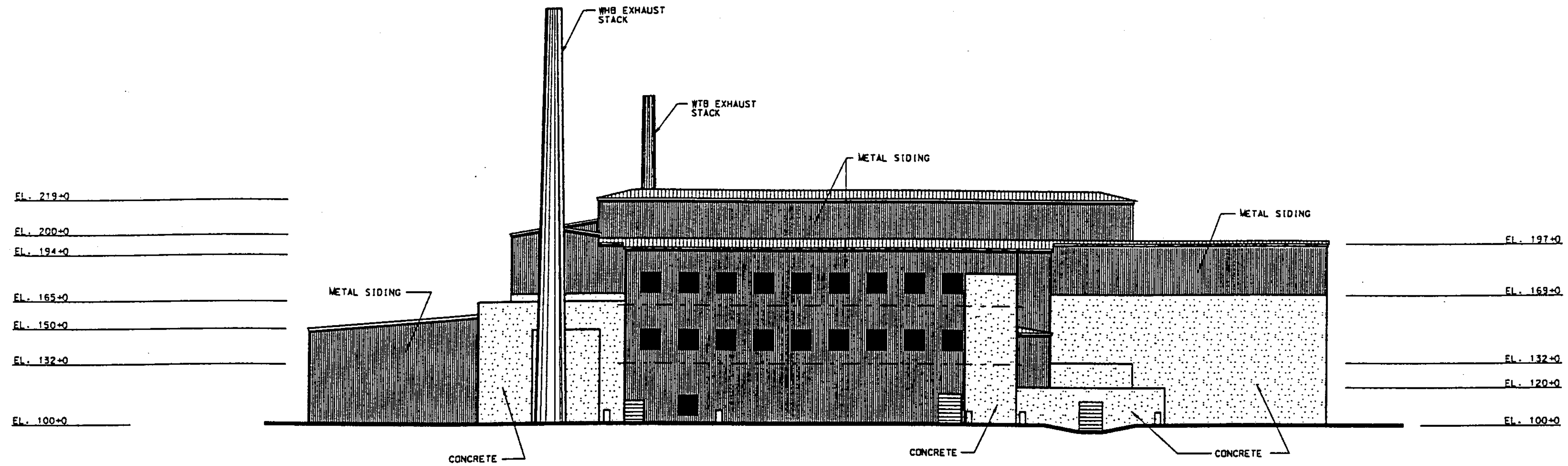


NORTH ELEVATION
SCALE: 1/32"=1'-0"

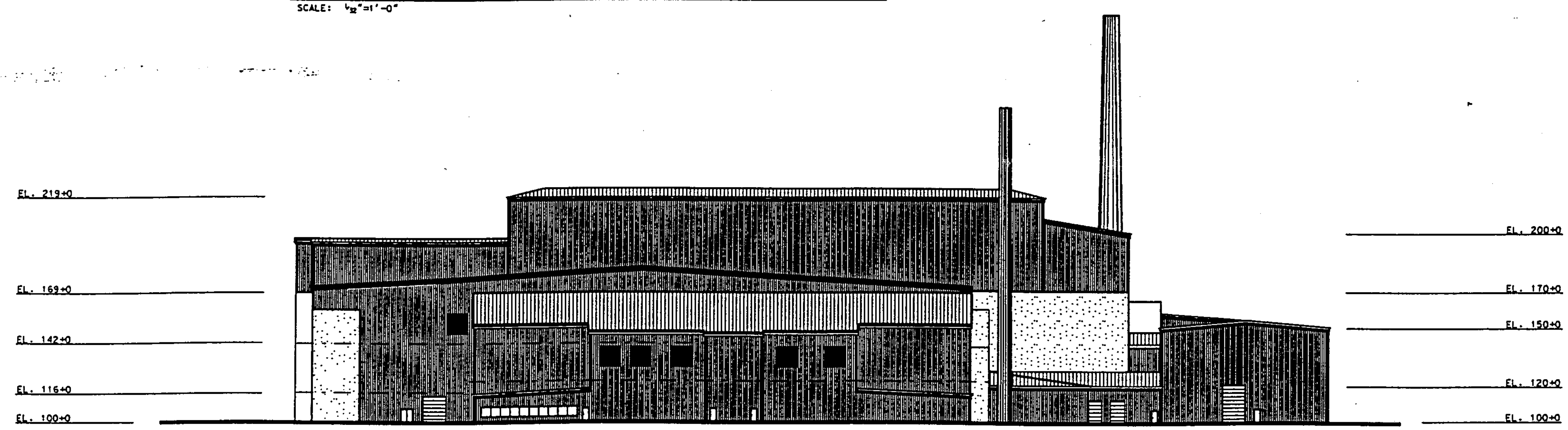
GRAPHIC SCALE
0 16 32 48 64 80 96 FEET
1/32 " = 1'-0"

FIGURE 15

WASTE HANDLING/WASTE TREATMENT BUILDING ELEVATIONS



WEST ELEVATION
SCALE: 1/32"=1'-0"

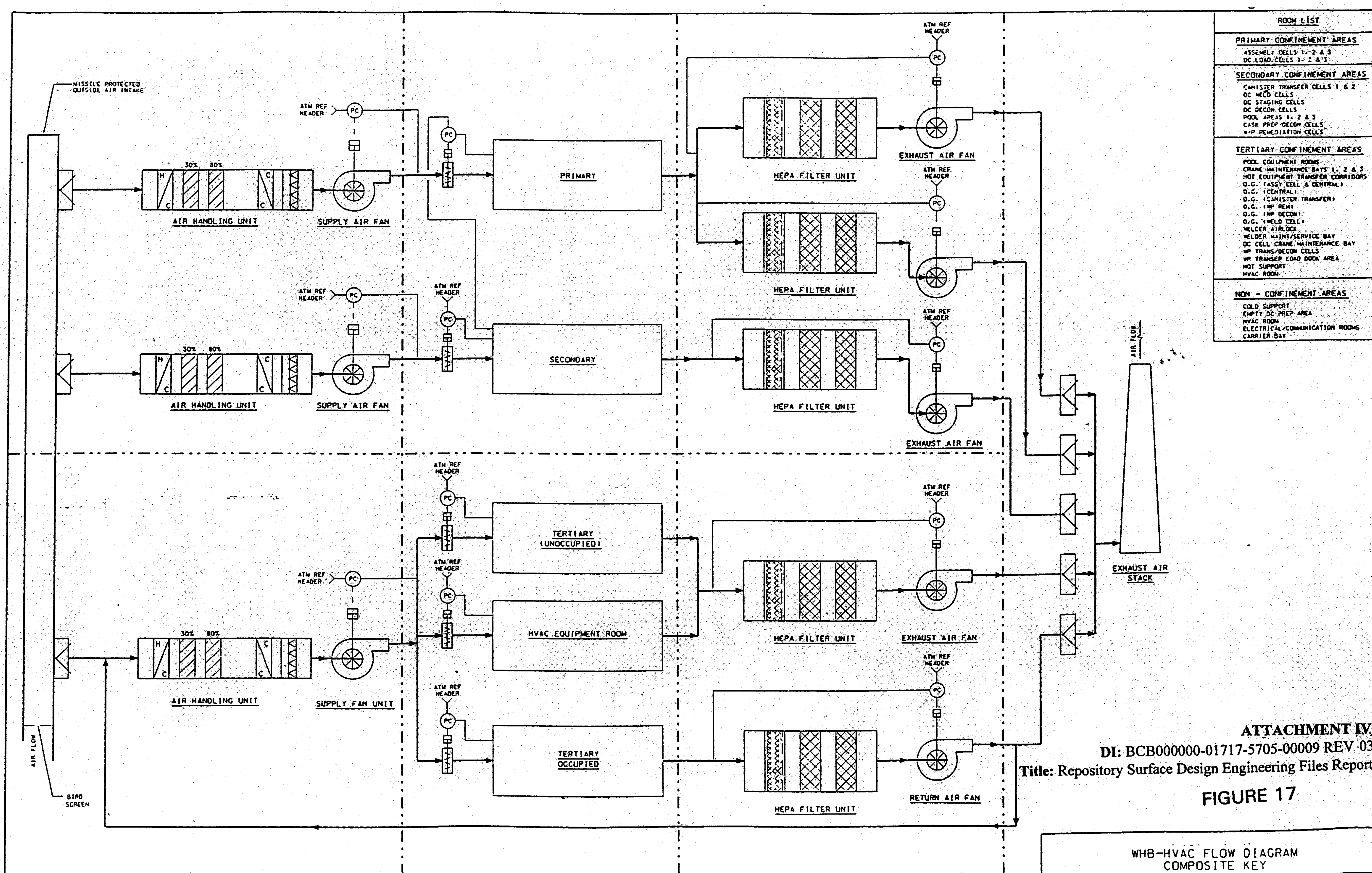


EAST ELEVATION
SCALE: 1/32"=1'-0"

GRAPHIC SCALE
0 16 32 48 64 80 96 FEET
1/32 " = 1'-0"

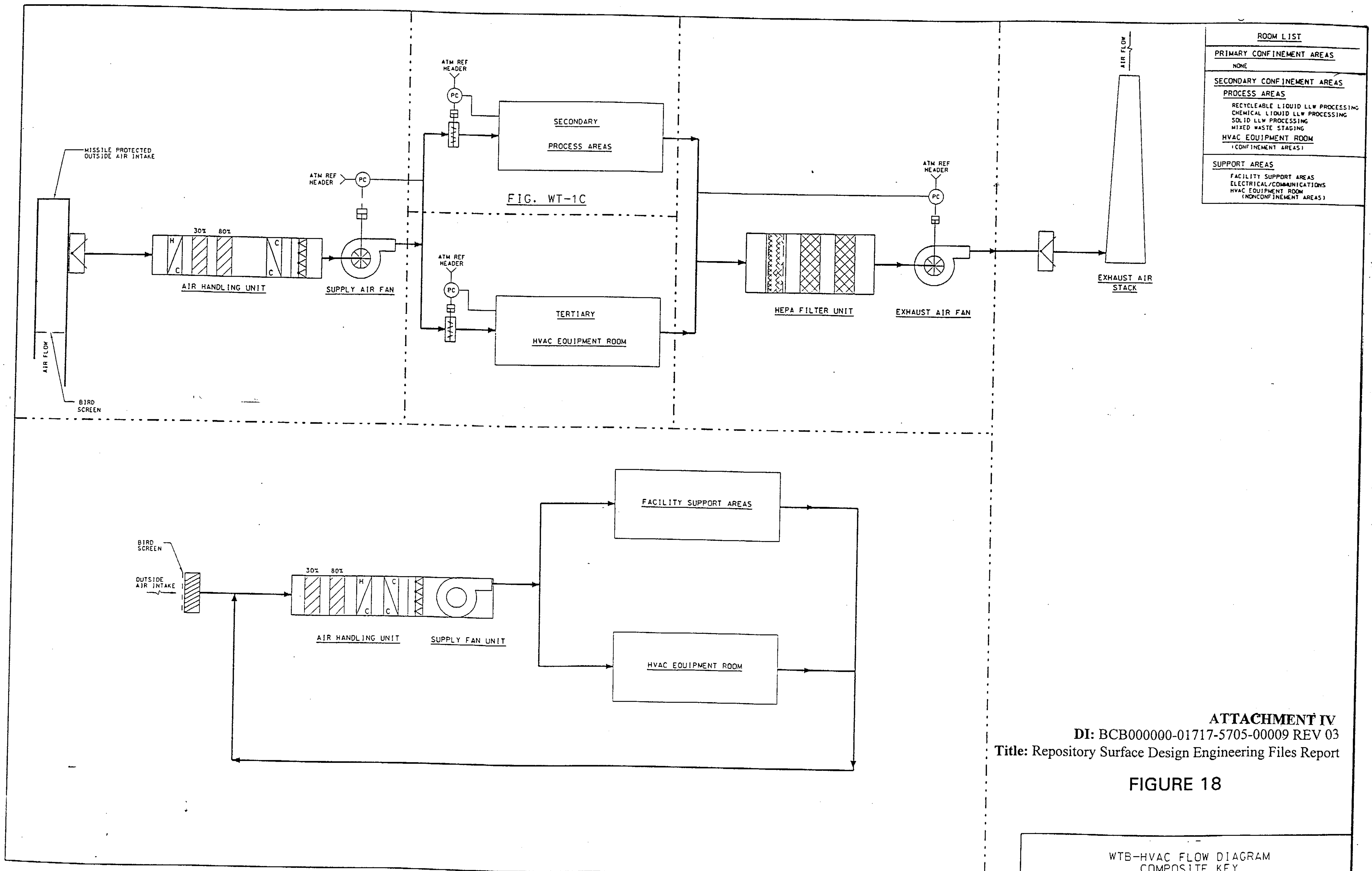
FIGURE 16

WASTE HANDLING/WASTE TREATMENT BUILDING ELEVATIONS



ATTACHMENT IV
DI: BCB000000-01717-5705-00009 REV 03
Title: Repository Surface Design Engineering Files Report

FIGURE 17



ATTACHMENT IV
DI: BCB000000-01717-5705-00009 REV 03
Title: Repository Surface Design Engineering Files Report

FIGURE 18

PEAK ANNUAL WASTE FORM RATES

SYSTEM	CARRIER/CASK TRANSPORT SYS.	CPB MATERIAL HANDLING SYS.	CARRIER/CASK HANDLING SYS.	ASSEMBLY TRANSFER SYS.	CANISTER TRANSFER SYS.	DISPOSAL CONTAINER HANDLING SYS.
SYSTEM IDENTIFIER	CT	CH	PH	PU	PC	PD
CASK CARRIERS	700	700	700	-	-	-
TRANSPORTATION CASKS	700	700	700	541	461	-
DUAL PURPOSE CANISTERS (DPC'S)	-	-	-	410	-	-
DUAL PURPOSE CANISTER OVER-PACKS	-	-	410	410	-	-
SPENT NUCLEAR FUEL ASSEMBLIES (SFA)	-	-	-	12,203	-	-
LARGE DISPOSABLE CANISTERS	-	-	-	-	300	-
SMALL DISPOSABLE CANISTERS	-	-	-	-	605	-
DISPOSAL CONTAINERS (DC)	-	-	-	380	502	582
WASTE PACKAGE TRANSPORTERS	-	-	-	-	-	582

WASTE FORMS HANDLED AT THE REPOSITORY

CASK CARRIER - RAIL CAR OR TRUCK TRAILER USED TO SHIP A TRANSPORTATION CASK.

TRANSPORTATION CASK - SHIELDED OVERPACK LICENSED TO TRANSPORT NUCLEAR WASTE. A CASK MAY CONTAIN UNCANISTERED SFA'S, A DPC OR DISPOSABLE CANISTERS.

DUAL PURPOSE CANISTER (DPC) - UNSHIELDED, WELDED CONTAINER DESIGNED TO CONFINE SFA'S DURING DRY STORAGE. A DPC IS SHIPPED TO THE REPOSITORY IN A TRANSPORTATION CASK BUT IS NOT DESIGNED FOR DISPOSAL IN THE REPOSITORY.

SPENT NUCLEAR FUEL ASSEMBLY (SFA) - A BUNDLE OF CLADDED FUEL RODS THAT HAVE BEEN IRRADIATED IN A NUCLEAR REACTOR (e.g. BWR OR PWR ASSEMBLIES).

DISPOSABLE CANISTER - UNSHIELDED, WELDED CONTAINERS OF HIGH-LEVEL WASTE THAT ARE DESIGNED TO BE PLACED DIRECTLY INTO A DC FOR DISPOSAL IN THE REPOSITORY. A DISPOSABLE CANISTER IS SHIPPED IN A TRANSPORTATION CASK. A LARGE DISPOSABLE CANISTER (e.g., MULTI-PURPOSE CANISTER) IS SHIPPED ONE PER CASK. A SMALL DISPOSABLE CANISTER (e.g., DEFENSE HIGH-LEVEL WASTE CANISTER) IS NORMALLY SHIPPED FIVE PER CASK.

DISPOSAL CONTAINER (DC) - UNSHIELDED CONTAINER DESIGNED TO PROVIDE LONG TERM WASTE ISOLATION FOR HIGH-LEVEL WASTE PLACED IN THE REPOSITORY. A DC READY FOR EMPLACEMENT IS REFERRED TO AS A WASTE PACKAGE (WP).

WASTE PACKAGE (WP) TRANSPORTER - SHIELDED, RAIL-MOUNTED CASK DESIGNED FOR HAULING A WASTE PACKAGE TO THE SUBSURFACE EMPLACEMENT DRIFT. THE TRANSPORTER IS HAULED WITH AN ELECTRIC LOCOMOTIVE.

NOTES:

1. THE MECHANICAL FLOW DIAGRAMS (MFD'S) FOR WASTE HANDLING OPERATIONS INCLUDE THE DRAWINGS LISTED ON THIS OVERVIEW DRAWING.
   A. UNLESS NOTED ALL DRAWINGS IN THE SERIES BCB000000-01717-2700-67000 THRU 67014 ARE ABBREVIATED 670XX.
   B. THE APPLICABLE SYMBOLS AND LEGENDS ARE SHOWN ON DRAWINGS BC0000000-01717-2700-90000, 90001, AND 90002.
2. THE OPERATIONS DESCRIBED ON THE MECHANICAL FLOW DIAGRAMS FOR THE SURFACE WASTE HANDLING OPERATIONS ARE REPRESENTATIVE OF MOST WASTE FORM CONFIGURATIONS.
3. CRANE CAPACITY CALLOUTS REPRESENT THE MAXIMUM LIFTING LOADS.
4. THE TYPES AND QUANTITIES OF HANDLING FIXTURES, YOKES, STANDS, AND GRAPPLES (FX EQUIPMENT IDENTIFIER) HAVE NOT BEEN DETERMINED BECAUSE SPECIFIC SHIPPING CASK AND WASTE FORM CONFIGURATIONS HAVE NOT BEEN ESTABLISHED. THEREFORE, EACH TYPE OF FIXTURE INCLUDES ONLY ONE EQUIPMENT IDENTIFIER.
5. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

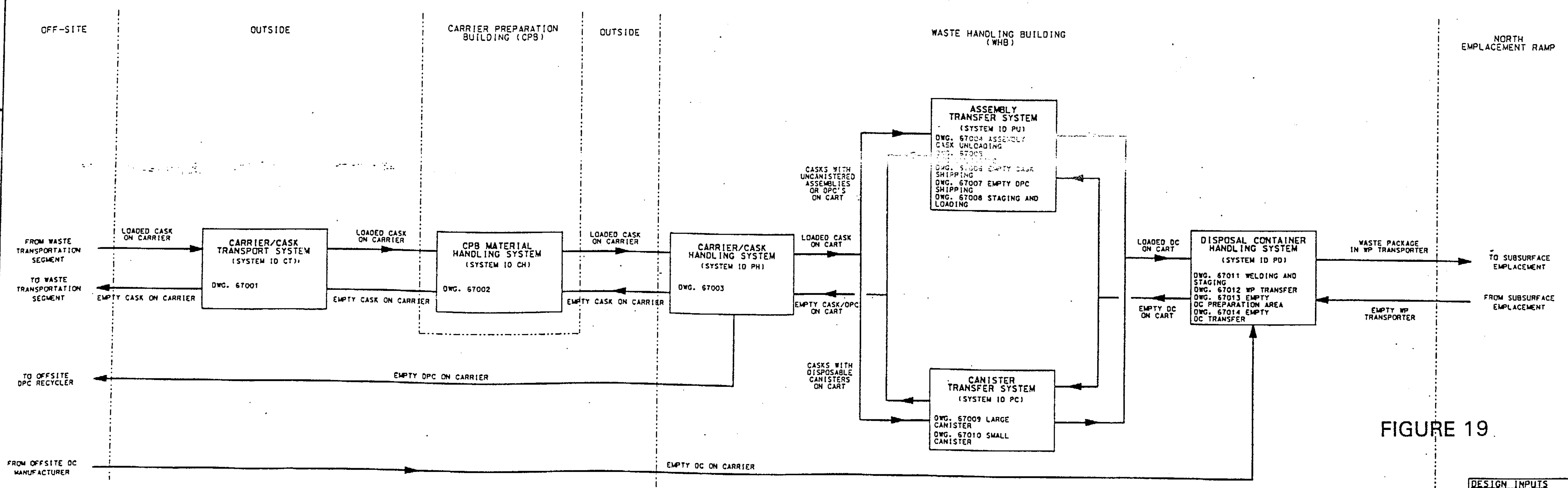


FIGURE 19

DESIGN INPUTS
SEE DRAWING INPUTS LIST

APPROVALS	INITIALS/DATE
DRAWN: T SAUER	TS 5-29-97
ORIGINATOR: K SCHWARTZTRAUBER	KS 5-29-97
CHECKED: R ZIMMERMAN	5-29-97
VERIFICATION: N/A	
LEAD DESIGN ENGINEER: K SCHWARTZTRAUBER	KS 5-29-97
QUALITY ASSURANCE: N/A	
DEPARTMENT MANAGER: S MEYERS	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - WASTE HANDLING OVERVIEW

SIZE: D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67000-00
SCALE: NONE | QA CLASSIFICATION: N/A | W.B.S.: 1.2.4.6 | CAD FILE: srm-sk011.dgn

REV	DESCRIPTION	DATE
00	ISSUE APPROVED	5-29-97

NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. LOADED CASKS/CARRIERS AND THE OFF-SITE PRIME MOVER ARE EXTERNALLY INSPECTED FOR CONTRABAND AND SABOTAGE PRIOR TO PASSING THE SECURITY GATE.
3. THE OFF-SITE PRIME MOVER DELIVERS THE CARRIER/CASK TO THE TRUCK OR RAIL PARKING AREAS. THEN WAITS FOR EMPTY CARRIER/CASK THAT IS READY FOR RETURN TO THE POINT OF ORIGIN.
4. EMPTY CASK SHIPMENTS ARE INSPECTED FOR RADIOLOGICAL CONTAMINATION AT THE SECURITY STATION PRIOR TO LEAVING THE SITE.
5. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

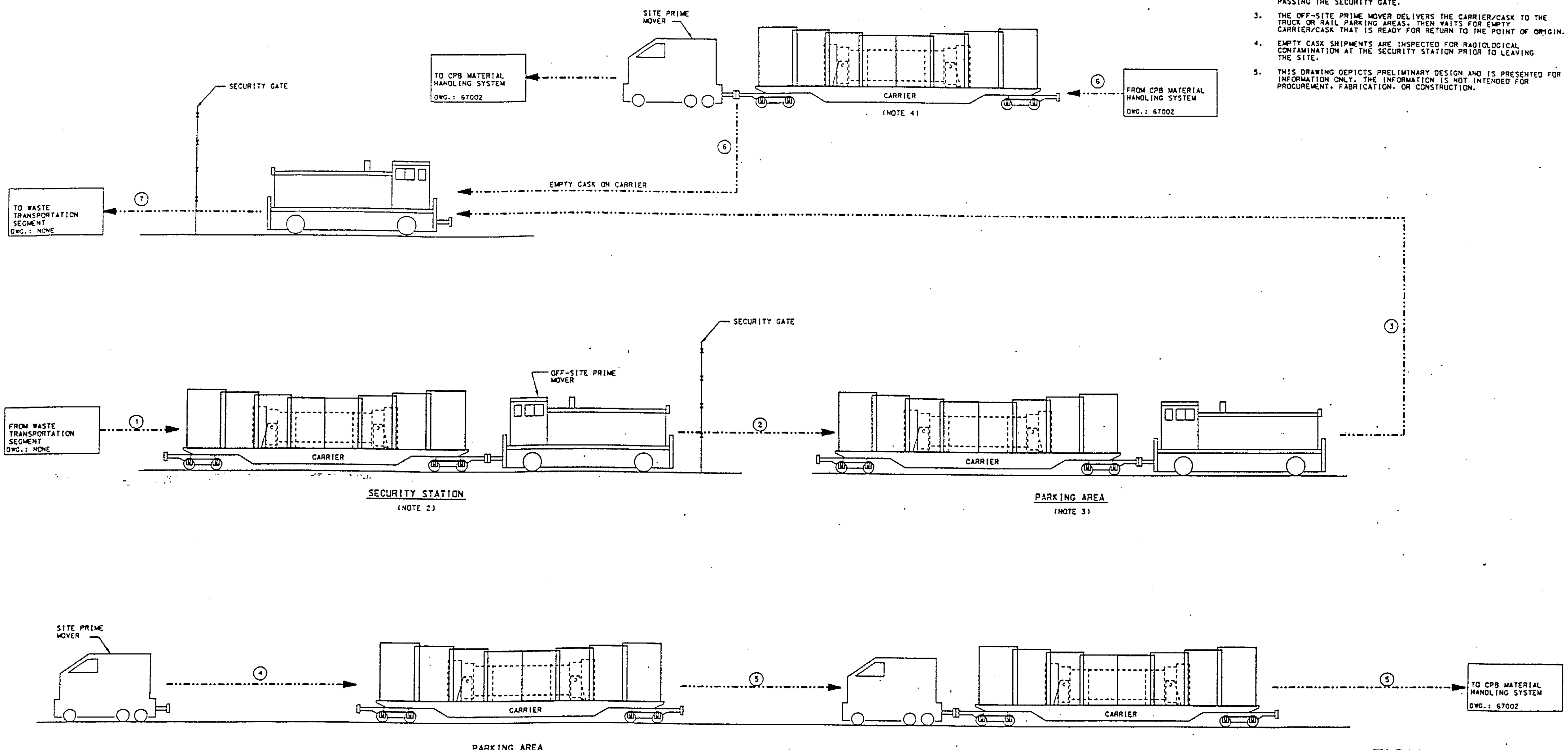


FIGURE 20

DESIGN INPUTS
SEE DRAWING INPUTS LIST

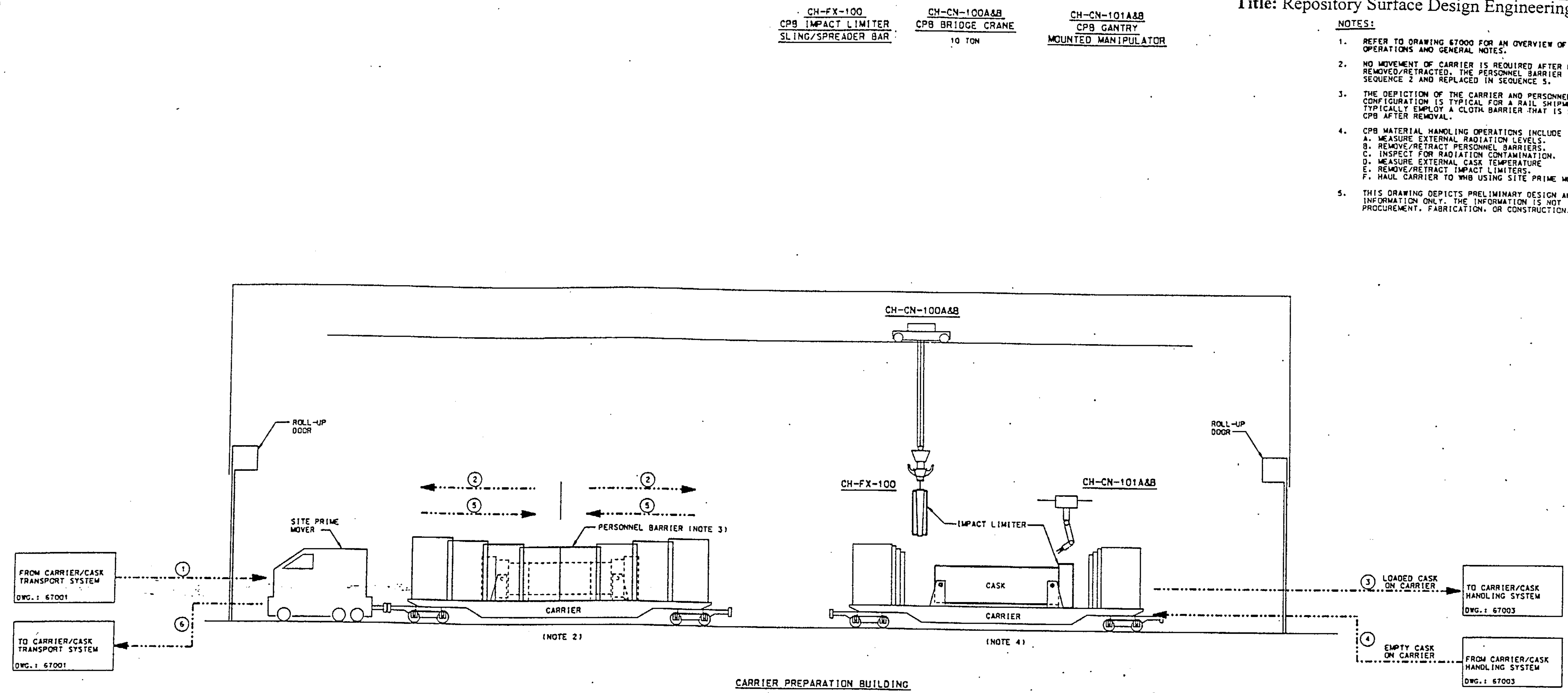
APPROVALS	INITIAL/DATE
DESIGN: T SAUER	5-29-97
ORIGINATOR: K SCHWARTZTRAUBER	5/29/97
CHECKED: R ZIMMERMAN	5/29/97
VERIFICATION: N/A	
LEAD DESIGN ENGINEER: K SCHWARTZTRAUBER	5/29/97
QUALITY ASSURANCE: N/A	
DEPARTMENT MANAGER: S MEYERS	5-29-97

REV	DESCRIPTION	DATE
00	ISSUE APPROVED	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - CARRIER/CASK TRANSPORT SYSTEM

SIZE D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67001-00
SCALE: NONE | QA CLASSIFICATION: N/A | W.B.S.: 1.2.4.6 | CAD FILE: srm-sk011.dgn



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. NO MOVEMENT OF CARRIER IS REQUIRED AFTER PERSONNEL BARRIER IS REMOVED/RETRACTED. THE PERSONNEL BARRIER IS RETRACTED IN SEQUENCE 2 AND REPLACED IN SEQUENCE 5.
3. THE DEPICTION OF THE CARRIER AND PERSONNEL BARRIER CONFIGURATION IS TYPICAL FOR A RAIL SHIPMENT. TRUCK SHIPMENTS TYPICALLY EMPLOY A CLOTH BARRIER THAT IS STAGED WITHIN THE CPB AFTER REMOVAL.
4. CPB MATERIAL HANDLING OPERATIONS INCLUDE THE FOLLOWING:
   A. MEASURE EXTERNAL RADIATION LEVELS.
   B. REMOVE/RETRACT PERSONNEL BARRIERS.
   C. INSPECT FOR RADIATION CONTAMINATION.
   D. MEASURE EXTERNAL CASK TEMPERATURE
   E. REMOVE/RETRACT IMPACT LIMITERS.
   F. HAUL CARRIER TO WHB USING SITE PRIME MOVER.
5. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

FIGURE 21

DESIGN INPUTS
SEE DRAWING INPUTS LIST

00	ISSUE APPROVED

APPROVALS	INITIAL/DATE
T SAUER	5-23-97
K SCHWARTZTRAUBER	KS 5-23-97
R ZIMMERMAN	5-23-97
N/A	
K SCHWARTZTRAUBER	KS 5-23-97
N/A	
S MEYERS	5-23-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - CPB MATERIAL HANDLING SYSTEM

SIZE D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67002-00
SCALE NONE | QA CLASSIFICATION N/A | W.B.S. 1.2.4.6 | CAD FILE srm-sk011.dgn

PH-FX-100
CB CASK
LIFTING YOKE

PH-CN-100
CB BRIDGE CRANE
125 TON

PH-EM-100A-C
CB GANTRY
MOUNTED MANIPULATOR

NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF THE WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. ROAD GRIME IS REMOVED FROM THE CASK AND CARRIER BEFORE ENTERING THE WASTE HANDLING BUILDING BY A WATER WASHDOWN DEVICE.
3. AFTER CASK REMOVAL, EMPTY CARRIER MAY BE REMOVED FROM THE CARRIER BAY, STAGED IN AN OUTSIDE PARKING AREA, AND THEN RETURNED TO THE CARRIER BAY WHEN THE EMPTY CASK IS AVAILABLE FOR SHIPMENT.
4. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

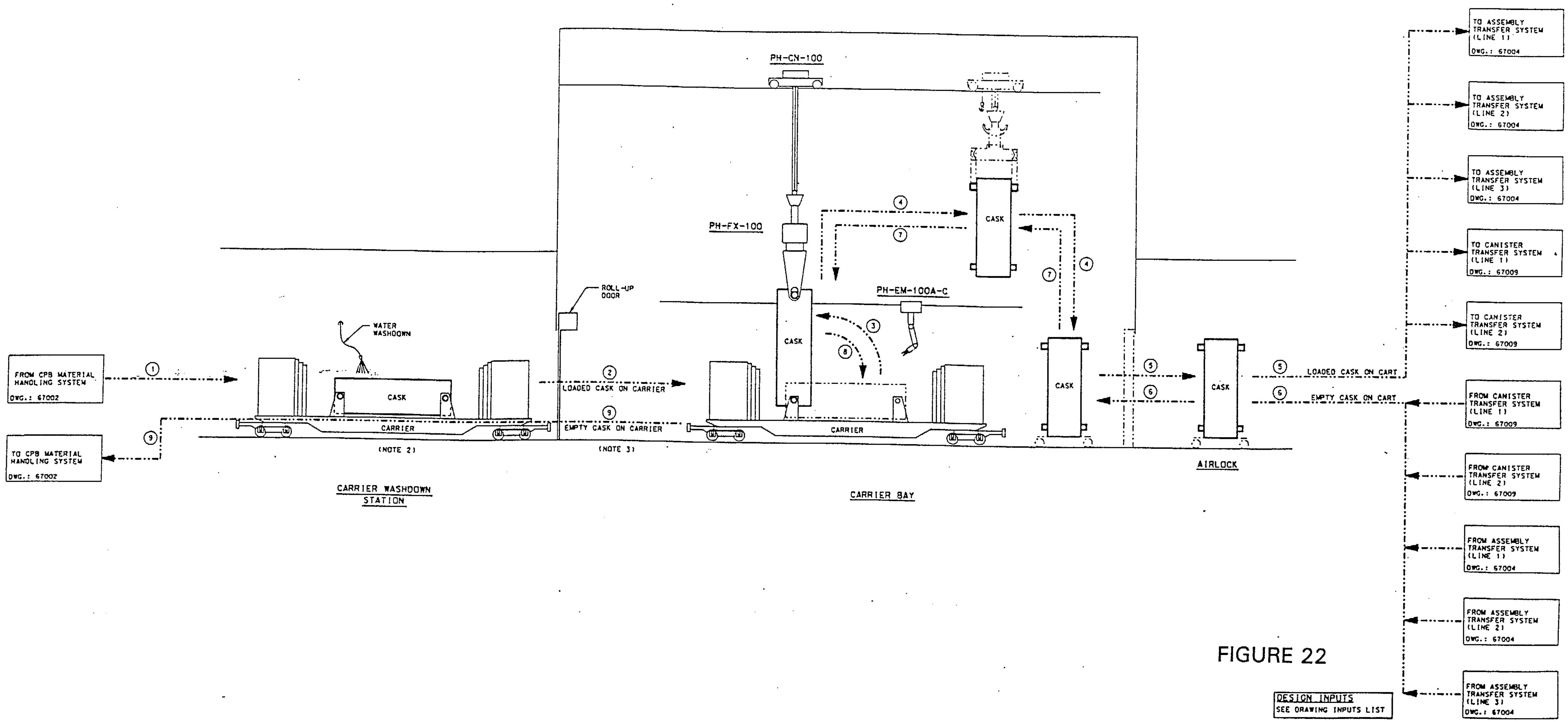


FIGURE 22

DESIGN INPUTS
SEE DRAWING INPUTS LIST

APPROVALS	INITIAL/DATE
DRAWN T SAUER	5-29-97
ORIGINATOR K SCHWARTZTRAUBER	5-29-97
CHECKED R ZIMMERMAN	5-29-97
CERTIFICATION N/A	
LEAD DESIGN ENGINEER K SCHWARTZTRAUBER	5-29-97
QUALITY ASSURANCE N/A	
DEPARTMENT MANAGER S MEYERS	5-29-97

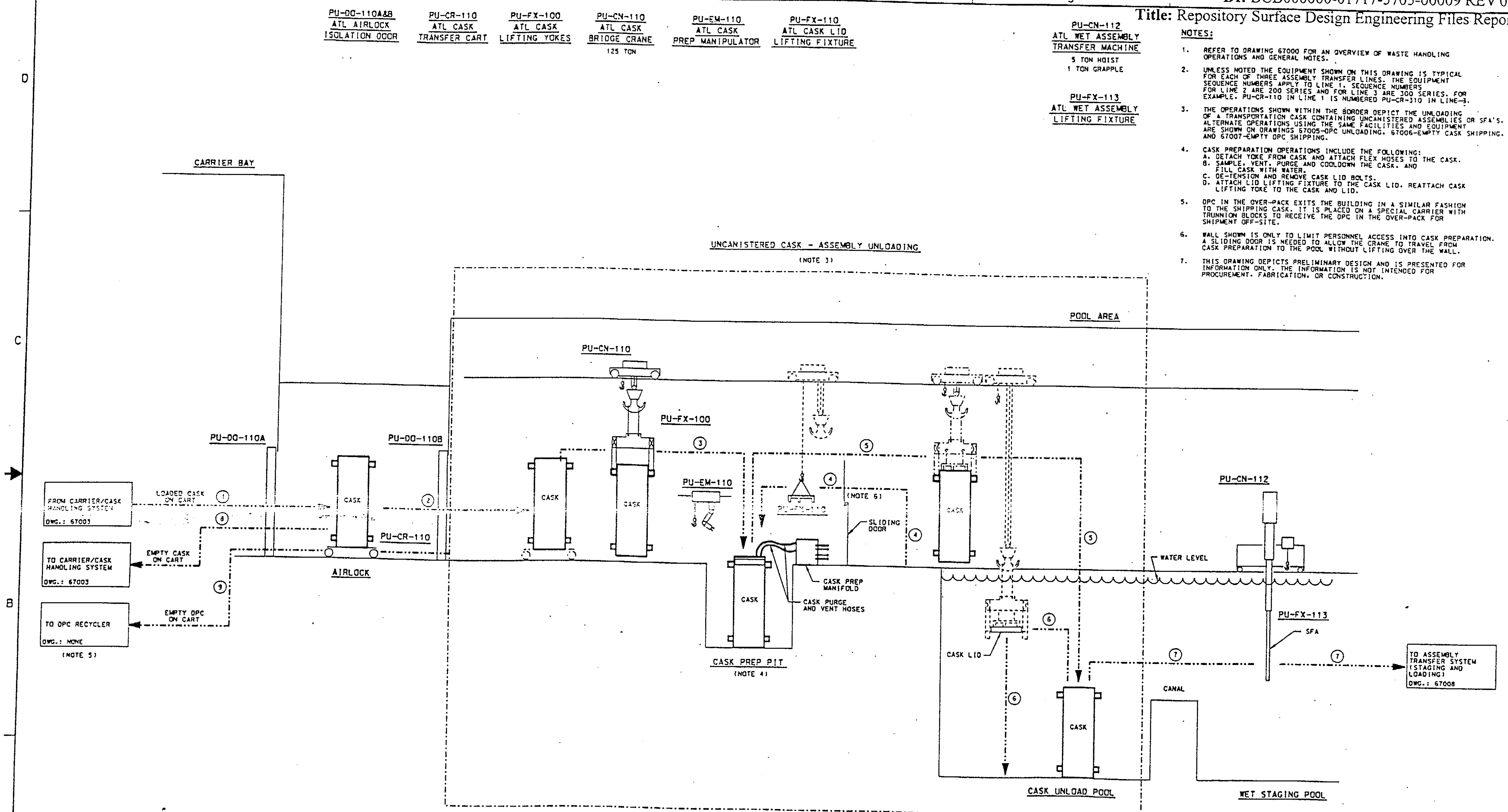
U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - CARRIER/CASK HANDLING SYSTEM

SIZE D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67003 | REV 00
SCALE NONE | QA CLASSIFICATION N/A | W.B.S. 1.2.4.6 | CAD FILE srm-sk011.dgn

00 | ISSUE APPROVED | 5-29-97 | N/A

D IDENTIFIER: BCB000000-01717-2700-67003-00



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF THREE ASSEMBLY TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES AND FOR LINE 3 ARE 300 SERIES. FOR EXAMPLE, PU-CR-110 IN LINE 1 IS NUMBERED PU-CR-310 IN LINE 3.
3. THE OPERATIONS SHOWN WITHIN THE BORDER DEPICT THE UNLOADING OF A TRANSPORTATION CASK CONTAINING UNCANISTERED ASSEMBLIES OR SFA'S. ALTERNATE OPERATIONS USING THE SAME FACILITIES AND EQUIPMENT ARE SHOWN ON DRAWINGS 67005-OPC UNLOADING, 67006-EMPTY CASK SHIPPING, AND 67007-EMPTY OPC SHIPPING.
4. CASK PREPARATION OPERATIONS INCLUDE THE FOLLOWING:
   A. DETACH YOKE FROM CASK AND ATTACH FLEX HOSES TO THE CASK.
   B. SAMPLE, VENT, PURGE AND COOLDOWN THE CASK, AND FILL CASK WITH WATER.
   C. DE-TENSION AND REMOVE CASK LID BOLTS.
   D. ATTACH LID LIFTING FIXTURE TO THE CASK LID. REATTACH CASK LIFTING YOKE TO THE CASK AND LID.
5. OPC IN THE OVER-PACK EXITS THE BUILDING IN A SIMILAR FASHION TO THE SHIPPING CASK. IT IS PLACED ON A SPECIAL CARRIER WITH TRUNNION BLOCKS TO RECEIVE THE OPC IN THE OVER-PACK FOR SHIPMENT OFF-SITE.
6. WALL SHOWN IS ONLY TO LIMIT PERSONNEL ACCESS INTO CASK PREPARATION. A SLIDING DOOR IS NEEDED TO ALLOW THE CRANE TO TRAVEL FROM CASK PREPARATION TO THE POOL WITHOUT LIFTING OVER THE WALL.
7. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

FIGURE 23

DESIGN INPUTS
SEE DRAWING INPUTS LIST

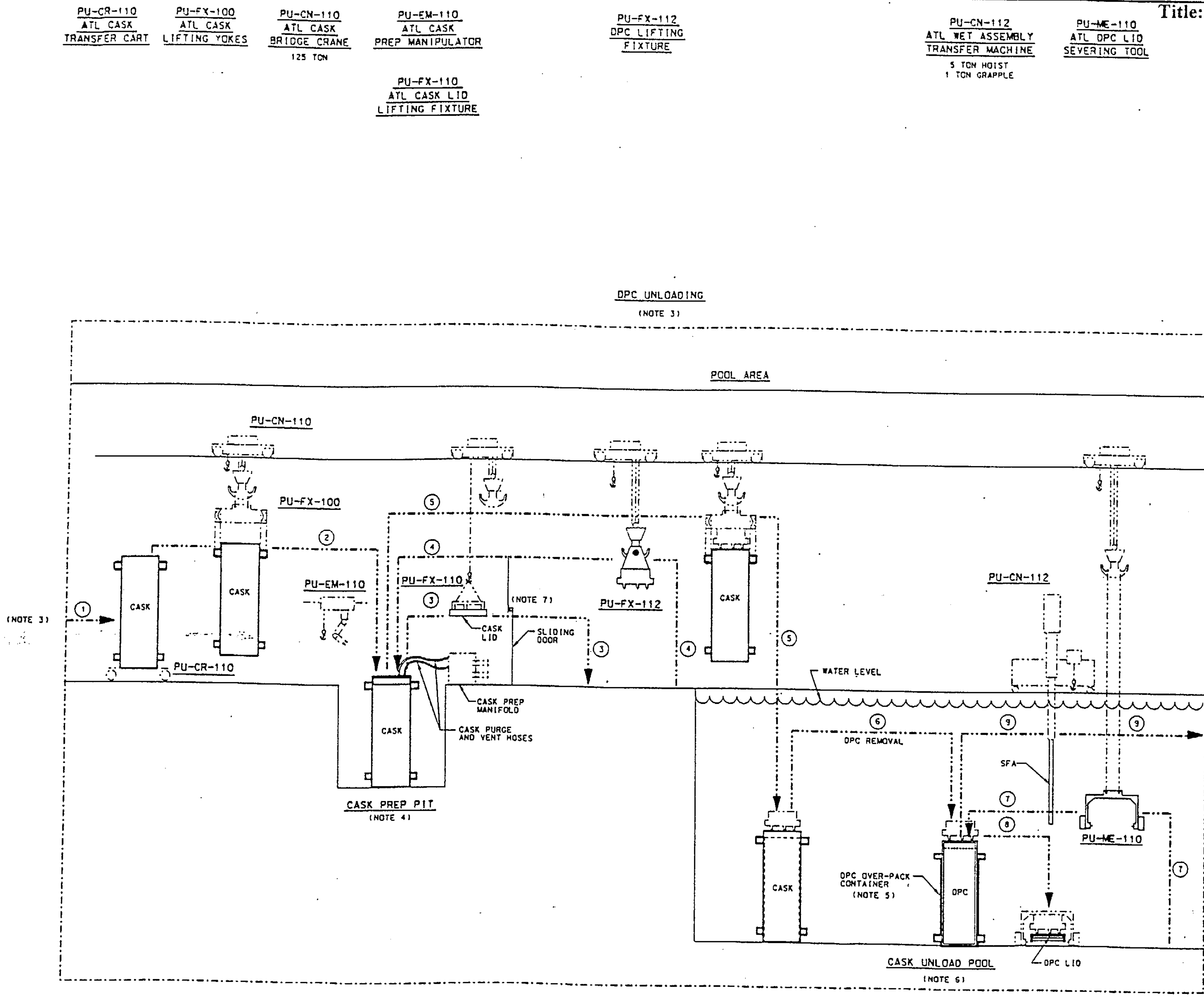
Approvals	Initial/Date
DRAWN: T SAUER	5-29-97
ORIGINATOR: K SCHWARTZTRAUBER	5-29-97
CHECKED: R ZIMMERMAN	5-29-97
VERIFICATION: N/A	
LEAD DESIGN ENGINEER: K SCHWARTZTRAUBER	5-29-97
QUALITY ASSURANCE: N/A	
DEPARTMENT MANAGER: S MEYERS	5-29-97

REV	DESCRIPTION	DATE
00	ISSUE APPROVED	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - ASSEMBLY TRANSFER SYSTEM (ASSEMBLY CASK UNLOADING)

SIZE: D | DOCUMENT IDENTIFIER: BCBD00000-01717-2700-67004 | REV: 00
SCALE: NONE | QA CLASSIFICATION: N/A | W.B.S.: 1.2.4.6 | CAD FILE: srm-sk011.dgn



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.

2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF THREE ASSEMBLY TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES AND FOR LINE 3 ARE 300 SERIES. FOR EXAMPLE. PU-CR-110 IN LINE 1 IS NUMBERED PU-CR-310 IN LINE 3.

3. THE OPERATIONS SHOWN ON THIS DRAWING DEPICT THE UNLOADING OF A TRANSPORTATION CASK CONTAINING A DPC. THESE ARE ALTERNATE OPERATIONS USING THE SAME FACILITIES AND SOME OF THE SAME EQUIPMENT SHOWN WITHIN THE BORDER ON DRAWING 67004.

4. CASK PREPARATION OPERATIONS INCLUDE THE FOLLOWING:
   A. DETACH YOKE FROM CASK AND ATTACH FLEX HOSES TO THE CASK.
   B. SAMPLE. VENT. PURGE AND COOLDOWN THE CASK.
   C. DE-TENSION AND REMOVE CASK LID BOLTS.
   D. ATTACH CASK LID LIFTING FIXTURE AND REMOVE THE CASK LID.
   E. ATTACH FLEX HOSES TO THE DPC.
   F. SAMPLE. VENT. PURGE AND COOLDOWN THE DPC. FILL DPC WITH WATER.
   G. DETACH FLEX HOSES.
   H. ATTACH DPC LIFTING FIXTURE TO THE DPC
   I. ATTACH THE CASK LIFTING YOKE TO THE DPC LIFTING FIXTURE AND CASK.

5. THE DPC OVER-PACK CONTAINER IS PLACED IN THE CASK UNLOAD POOL PRIOR TO CASK UNLOADING.

6. CASK UNLOAD POOL OPERATIONS INCLUDE THE FOLLOWING:
   A. THE DPC IS LIFTED UNDERWATER. REMOVED FROM THE CASK. AND INSERTED INTO THE DPC OVER-PACK CONTAINER
   B. THE CRANE YOKE AND DPC LIFTING YOKE ARE DISENGAGED
   C. THE DPC LID SEVERING DEVICE IS ENGAGED BY THE CRANE AND INSTALLED OVER THE DPC LID
   D. THE DPC LID IS SEVERED AND THE DPC LID. LIFTING FIXTURE. SEVERING DEVICE. AND CUTTINGS ARE STAGED OR REMOVED
   E. THE ASSEMBLIES OR SFA'S IN THE DPC ARE UNLOADED WITH THE WET ASSEMBLY TRANSFER MACHINE.
   F. THE EMPTY CASK IS SHIPPED AS SHOWN ON DWG 67006.

7. WALL SHOWN IS ONLY TO LIMIT PERSONNEL ACCESS INTO CASK PREPARATION. A SLIDING DOOR IS NEEDED TO ALLOW THE CRANE TO TRAVEL FROM CASK PREPARATION TO THE POOL WITHOUT LIFTING OVER THE WALL.

8. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT. FABRICATION. OR CONSTRUCTION.

FIGURE 24

DESIGN INPUTS
SEE DRAWING INPUTS LIST

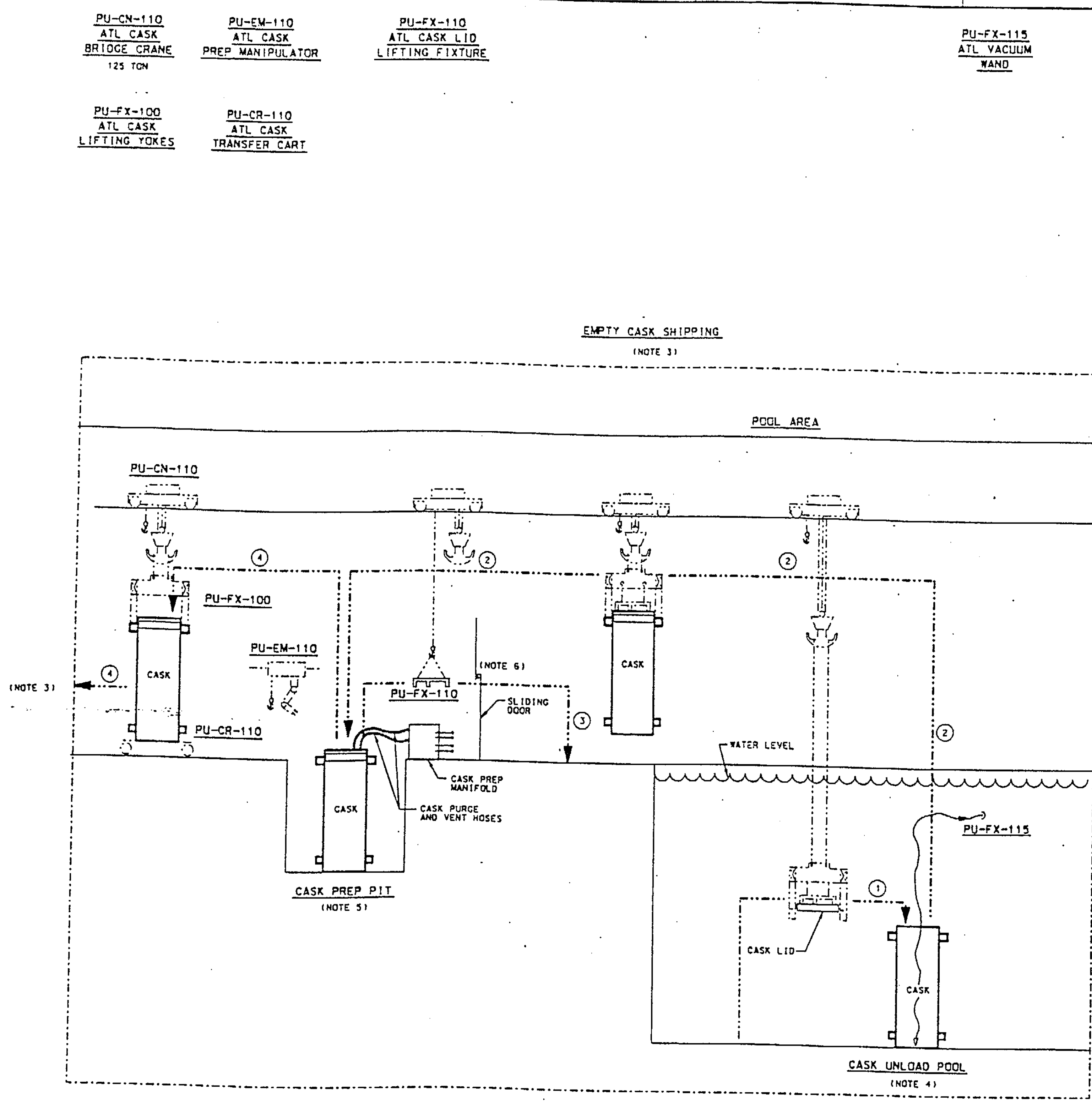
APPROVALS	INITIAL/DATE
T SAUER	5-27-97
K SCHWARTZTRAUBER	5-28-97
R ZIMMERMAN	5-29-97
N/A	
K SCHWARTZTRAUBER	5-28-97
N/A	
S MEYERS	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - ASSEMBLY TRANSFER SYSTEM (DPC UNLOADING)

SIZE D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67005-00
SCALE NONE | N/A | 1.2.4.6 | srm-sk011.dgn

00 ISSUE APPROVED 5-29-97



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF THREE ASSEMBLY TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES AND FOR LINE 3 ARE 300 SERIES. FOR EXAMPLE, PU-CR-110 IN LINE 1 IS NUMBERED PU-CR-310 IN LINE 3.
3. THE OPERATIONS SHOWN ON THIS DRAWING DEPICT THE PREPARATION OF AN EMPTY TRANSPORTATION CASK FOR REMOVAL FROM THE ASSEMBLY TRANSFER LINE. THESE ARE ALTERNATE OPERATIONS USING THE SAME FACILITIES AND SOME OF THE SAME EQUIPMENT SHOWN WITHIN THE BORDER ON DRAWING 67004.
4. THE INSIDE OF THE EMPTY CASK IS CLEANED AS REQUIRED WITH A WET VACUUM SYSTEM PRIOR TO REMOVAL FROM THE POOL. THE OUTSIDE OF THE CASK IS WASHED WITH DEMINERALIZED WATER AT THE SURFACE OF THE POOL.
5. CASK PREPARATION OPERATIONS INCLUDE THE FOLLOWING:
   A. REMOVE YOKE, CASK LID LIFTING FIXTURE, AND INSTALL LID BOLTS.
   B. ATTACH FLEX HOSES TO THE CASK. REMOVE POOL WATER. VACUUM DRY. CONDUCT LEAK CHECK, AND BACKFILL WITH GAS (IF REQUIRED).
   C. REMOVE FLEX HOSES.
   D. DECONTAMINATE THE EXTERNAL SURFACES OF THE CASK AND INSPECT FOR RADIOLOGICAL CONTAMINATION.
6. WALL SHOWN IS ONLY TO LIMIT PERSONNEL ACCESS INTO CASK PREPARATION. A SLIDING DOOR IS NEEDED TO ALLOW THE CRANE TO TRAVEL FROM THE POOL TO CASK PREPARATION WITHOUT LIFTING OVER THE WALL.
7. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

FIGURE 25

DESIGN INPUTS
SEE DRAWING INPUTS LIST

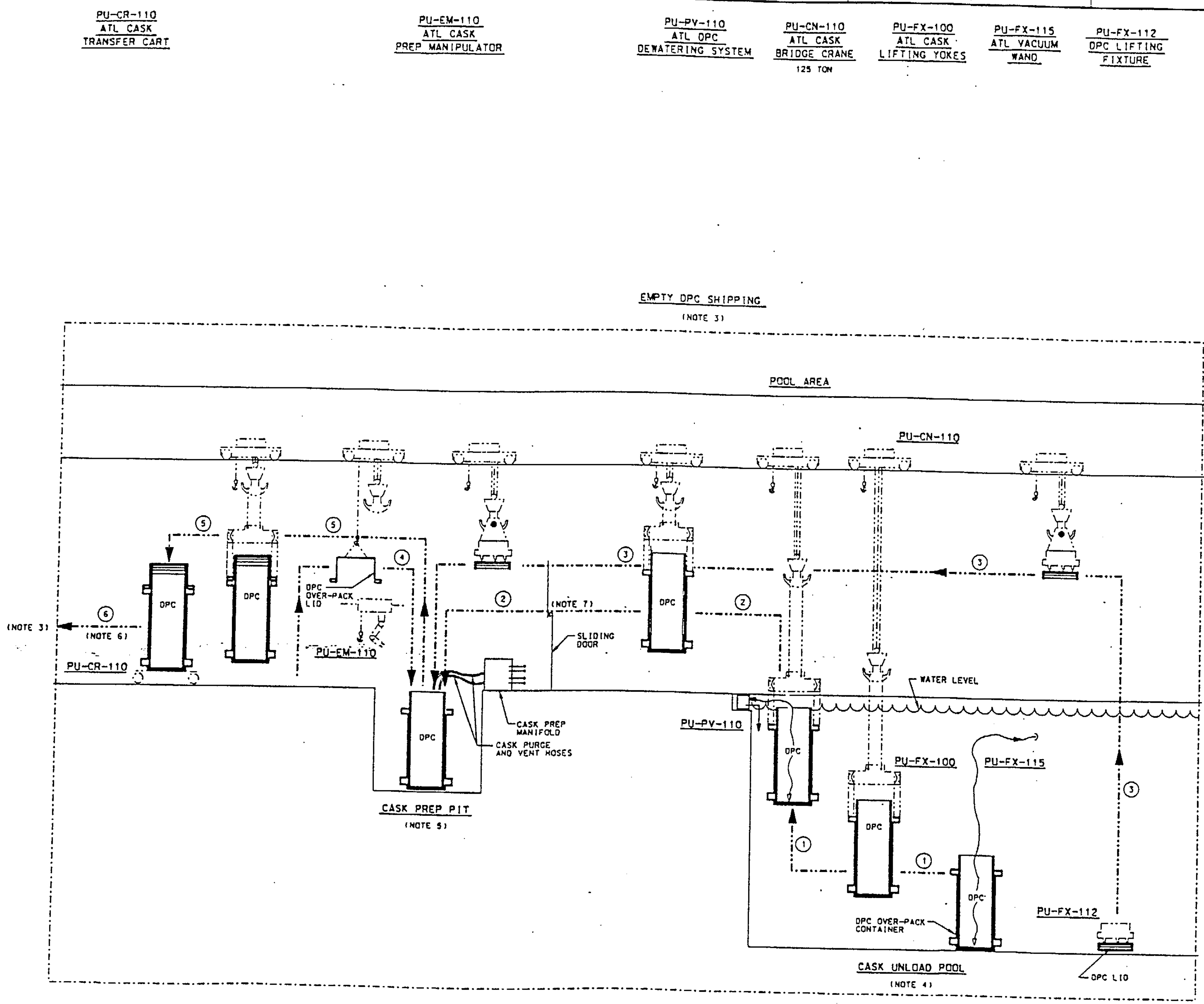
APPROVALS	INITIAL/DATE
DRAWN: T SAUER	TS 5-29-97
ORIGINATOR: K SCHWARTZTRAUBER	KS 5-29-97
CHECKED: R ZIMMERMAN	RZ 5-29-97
VERIFICATION: N/A	
LEAD DESIGN CONTROL: K SCHWARTZTRAUBER	KS 5-29-97
QUALITY ASSURANCE: N/A	
DEPARTMENT MANAGER: S MEYERS	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - ASSEMBLY TRANSFER SYSTEM (EMPTY CASK SHIPPING)

SIZE: D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67006-00
SCALE: NONE | QA CLASSIFICATION: N/A | W.B.S.: 1.2.4.6 | CAD FILE: srm-sk011.dgn

REV	DESCRIPTION	DATE
00	ISSUE APPROVED	5-29-97



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF THE WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF THREE ASSEMBLY TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES AND FOR LINE 3 ARE 300 SERIES. FOR EXAMPLE, PU-CR-110 IN LINE 1 IS NUMBERED PU-CR-310 IN LINE 3.
3. THE OPERATIONS SHOWN ON THIS DRAWING DEPICT THE PREPARATION OF AN EMPTY OPC FOR REMOVAL FROM THE ASSEMBLY TRANSFER LINE. THESE ARE ALTERNATE OPERATIONS USING THE SAME FACILITIES AND SOME OF THE SAME EQUIPMENT SHOWN WITHIN THE BORDER ON DRAWING 67004.
4. THE INSIDE OF THE EMPTY OPC IS CLEANED AS REQUIRED WITH A WET VACUUM SYSTEM PRIOR TO REMOVAL FROM THE POOL. THE OPC IS RAISED TO JUST ABOVE THE WATERLINE WHERE THE WATER IS PUMPED OUT. THE OUTSIDE OF THE OPC OVER-PACK AND LID ARE WASHED WITH DEMINERALIZED WATER AT THE SURFACE OF THE POOL.
5. OPC PREPARATION OPERATIONS INCLUDE THE FOLLOWING:
   A. DETACH YOKE AND PLACE OPC LID ON OPC.
   B. INSTALL OPC OVER-PACK LID ON OPC OVER-PACK AND BOLT.
   C. IF REQUIRED, ATTACH FLEX HOSES TO THE OPC OVER-PACK, VACUUM DRY, AND REMOVE FLEX HOSES.
   D. DECONTAMINATE THE EXTERNAL SURFACES OF THE OPC OVER-PACK AND INSPECT FOR RADIOLOGICAL CONTAMINATION.
6. OPC EXITS TO CARRIER BAY SIMILAR TO THE SHIPPING CASK.
7. WALL SHOWN IS ONLY TO LIMIT PERSONNEL ACCESS INTO CASK PREPARATION. A SLIDING DOOR IS NEEDED TO ALLOW THE CRANE TO TRAVEL FROM THE POOL TO CASK PREPARATION WITHOUT LIFTING OVER THE WALL.
8. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

FIGURE 26

DESIGN INPUTS
SEE DRAWING INPUTS LIST

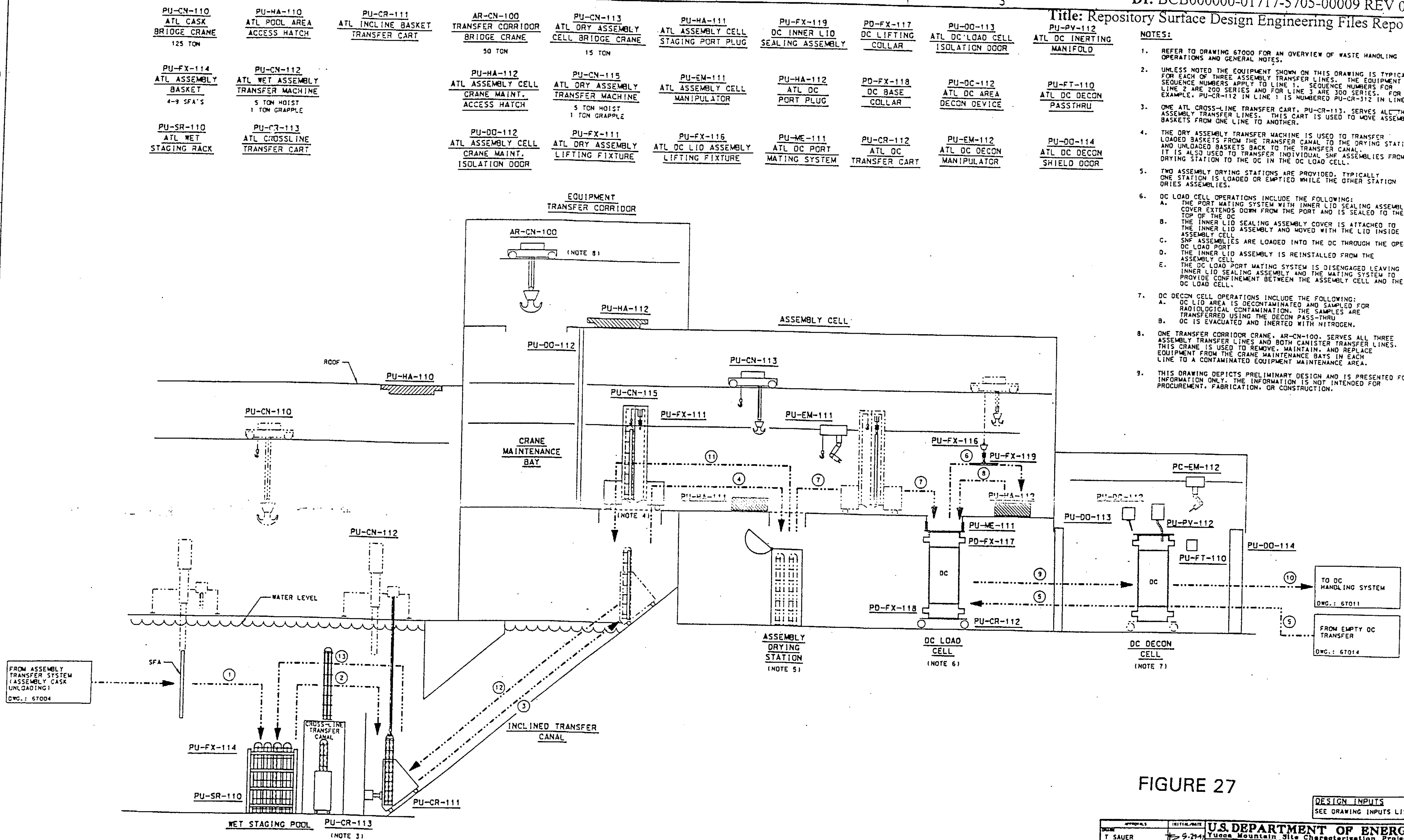
APPROVALS	INITIAL/DATE
DRAWN: T SAUER	5-29-97
ORIGINATOR: K SCHWARTZTRAUBER	5-28-97
CHECKER: R ZIMMERMAN	5-29-97
VERIFICATION: N/A	
LEAD DESIGN ENGINEER: K SCHWARTZTRAUBER	5-28-97
QUALITY ASSURANCE: N/A	
DEPARTMENT MANAGER: S MEYERS	5-29-97

REV	DESCRIPTION
00	ISSUE APPROVED

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - ASSEMBLY TRANSFER SYSTEM (EMPTY DPC SHIPPING)

SIZE: D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67007-00
SCALE: NONE | CLASSIFICATION: N/A | W.B.S.: 1.2.4.6 | CAD FILE: srm-sk011.dgn



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF THREE ASSEMBLY TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES AND FOR LINE 3 ARE 300 SERIES. FOR EXAMPLE, PU-CR-112 IN LINE 1 IS NUMBERED PU-CR-312 IN LINE 3.
3. ONE ATL CROSS-LINE TRANSFER CART, PU-CR-113, SERVES ALL THREE ASSEMBLY TRANSFER LINES. THIS CART IS USED TO MOVE ASSEMBLY BASKETS FROM ONE LINE TO ANOTHER.
4. THE DRY ASSEMBLY TRANSFER MACHINE IS USED TO TRANSFER LOADED BASKETS FROM THE TRANSFER CANAL TO THE DRYING STATION AND UNLOADED BASKETS BACK TO THE TRANSFER CANAL. IT IS ALSO USED TO TRANSFER INDIVIDUAL SNF ASSEMBLIES FROM THE DRYING STATION TO THE DC IN THE DC LOAD CELL.
5. TWO ASSEMBLY DRYING STATIONS ARE PROVIDED. TYPICALLY ONE STATION IS LOADED OR EMPTIED WHILE THE OTHER STATION DRIES ASSEMBLIES.
6. DC LOAD CELL OPERATIONS INCLUDE THE FOLLOWING:
   A. THE PORT MATING SYSTEM WITH INNER LID SEALING ASSEMBLY COVER EXTENDS DOWN FROM THE PORT AND IS SEALED TO THE TOP OF THE DC
   B. THE INNER LID SEALING ASSEMBLY COVER IS ATTACHED TO THE INNER LID ASSEMBLY AND MOVED WITH THE LID INSIDE THE ASSEMBLY CELL
   C. SNF ASSEMBLIES ARE LOADED INTO THE DC THROUGH THE OPEN DC LOAD PORT
   D. THE INNER LID ASSEMBLY IS REINSTALLED FROM THE ASSEMBLY CELL
   E. THE DC LOAD PORT MATING SYSTEM IS DISENGAGED LEAVING THE INNER LID SEALING ASSEMBLY AND THE MATING SYSTEM TO PROVIDE CONFINEMENT BETWEEN THE ASSEMBLY CELL AND THE DC LOAD CELL.
7. DC DECON CELL OPERATIONS INCLUDE THE FOLLOWING:
   A. DC LID AREA IS DECONTAMINATED AND SAMPLED FOR RADIOLOGICAL CONTAMINATION. THE SAMPLES ARE TRANSFERRED USING THE DECON PASS-THRU
   B. DC IS EVACUATED AND INERTED WITH NITROGEN.
8. ONE TRANSFER CORRIDOR CRANE, AR-CN-100, SERVES ALL THREE ASSEMBLY TRANSFER LINES AND BOTH CANISTER TRANSFER LINES. THIS CRANE IS USED TO REMOVE, MAINTAIN, AND REPLACE EQUIPMENT FROM THE CRANE MAINTENANCE BAYS IN EACH LINE TO A CONTAMINATED EQUIPMENT MAINTENANCE AREA.
9. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

FIGURE 27

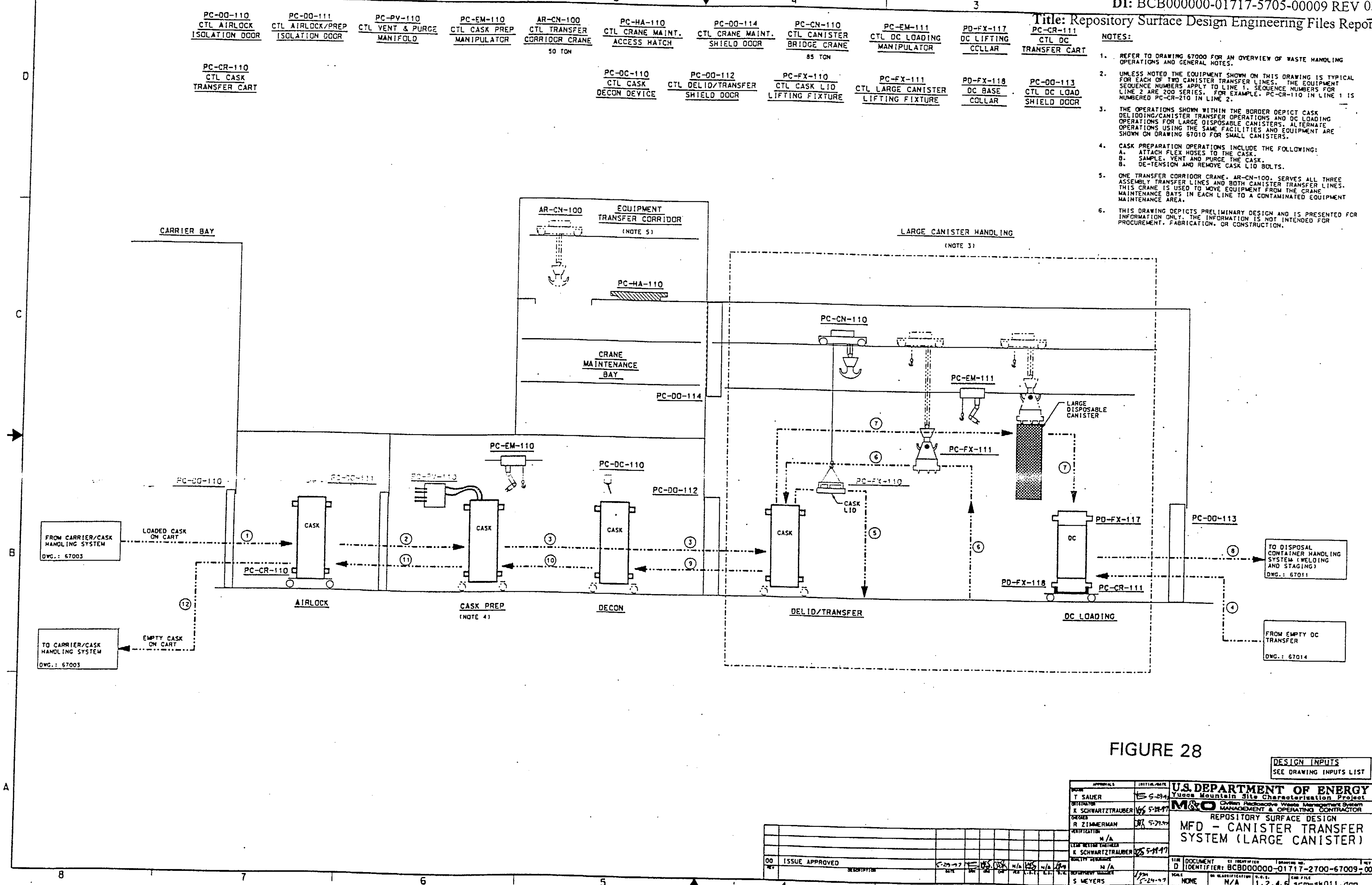
DESIGN INPUTS
SEE DRAWING INPUTS LIST

APPROVALS	INITIAL/DATE
DRAWN T SAUER	5-29-97
ORIGINATOR K SCHWARTZTRAUBER	VS 5-29-97
CHECKED R ZIMMERMAN	5-29-97
VERIFICATION N/A	
LEAD DESIGN ENGINEER K SCHWARTZTRAUBER	VS 5/29/97
QUALITY ASSURANCE N/A	
DEPARTMENT MANAGER S MEYERS	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
REPOSITORY SURFACE DESIGN
MFD - ASSEMBLY TRANSFER SYSTEM (STAGING AND LOADING)

SIZE D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67008-00
SCALE NONE | QA CLASSIFICATION N/A | W.B.S. 1.2.4.6 | CAD FILE srm-sk011.dgn

00 ISSUE APPROVED 5-29-97



NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF TWO CANISTER TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES. FOR EXAMPLE, PC-CR-110 IN LINE 1 IS NUMBERED PC-CR-210 IN LINE 2.
3. THE OPERATIONS SHOWN WITHIN THE BORDER DEPICT CASK DELIDDING/CANISTER TRANSFER OPERATIONS AND DC LOADING OPERATIONS FOR LARGE DISPOSABLE CANISTERS. ALTERNATE OPERATIONS USING THE SAME FACILITIES AND EQUIPMENT ARE SHOWN ON DRAWING 67010 FOR SMALL CANISTERS.
4. CASK PREPARATION OPERATIONS INCLUDE THE FOLLOWING:
   A. ATTACH FLEX HOSES TO THE CASK.
   B. SAMPLE, VENT AND PURGE THE CASK.
   C. DE-TENSION AND REMOVE CASK LID BOLTS.
5. ONE TRANSFER CORRIDOR CRANE, AR-CN-100, SERVES ALL THREE ASSEMBLY TRANSFER LINES AND BOTH CANISTER TRANSFER LINES. THIS CRANE IS USED TO MOVE EQUIPMENT FROM THE CRANE MAINTENANCE BAYS IN EACH LINE TO A CONTAMINATED EQUIPMENT MAINTENANCE AREA.
6. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

FIGURE 28

DESIGN INPUTS
SEE DRAWING INPUTS LIST

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - CANISTER TRANSFER SYSTEM (LARGE CANISTER)

DRAWN	T SAUER 5-29-97
ORIGINATOR	K SCHWARTZTRAUBER 5-29-97
CHECKED	R ZIMMERMAN 5-29-97
VERIFICATION	N/A
LEAD DESIGN ENGINEER	K SCHWARTZTRAUBER 5-29-97
QUALITY ASSURANCE	N/A
DEPARTMENT MANAGER	S MEYERS 5-29-97

REV	DESCRIPTION	DATE
00	ISSUE APPROVED	5-29-97

SIZE D DOCUMENT IDENTIFIER: BCB000000-01717-2700-67009-00
SCALE NONE | N/A | 1.2.4.6 | srm-sk011.dgn

PC-CN-110 CTL CANISTER BRIDGE CRANE 85 TON

PC-FX-110 CTL CASK LID LIFTING FIXTURE

PC-FX-112 CTL SMALL CANISTER LIFTING FIXTURE

PC-SR-110 SMALL CANISTER STAGING RACK

PD-FX-118 DC BASE COLLAR

PD-FX-117 DC LIFTING COLLAR

PC-CR-111 CTL DC TRANSFER CART

NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF THE WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. UNLESS NOTED THE EQUIPMENT SHOWN ON THIS DRAWING IS TYPICAL FOR EACH OF TWO CANISTER TRANSFER LINES. THE EQUIPMENT SEQUENCE NUMBERS APPLY TO LINE 1. SEQUENCE NUMBERS FOR LINE 2 ARE 200 SERIES. FOR EXAMPLE, PC-CR-111 IN LINE 1 IS NUMBERED PC-CR-211 IN LINE 2.
3. THE OPERATIONS SHOWN ON THIS DRAWING DEPICT CASK DELIDDING/CANISTER TRANSFER OPERATIONS AND DC LOADING OPERATIONS FOR SMALL DISPOSABLE CANISTERS. THESE ARE ALTERNATE OPERATIONS USING THE SAME FACILITIES AND SOME OF THE SAME EQUIPMENT SHOWN WITHIN THE BORDER ON DRAWING 67009, FOR LARGE CANISTERS.
4. A SMALL CANISTER STAGING RACK IS PROVIDED TO ACCUMULATE ENOUGH COMPATIBLE CANISTERS TO COMPLETELY LOAD A DC. WHEN POSSIBLE, CANISTERS WILL BYPASS THE RACK AND BE LOADED DIRECTLY INTO A DC.
5. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

SMALL CANISTER HANDLING
(NOTE 3)

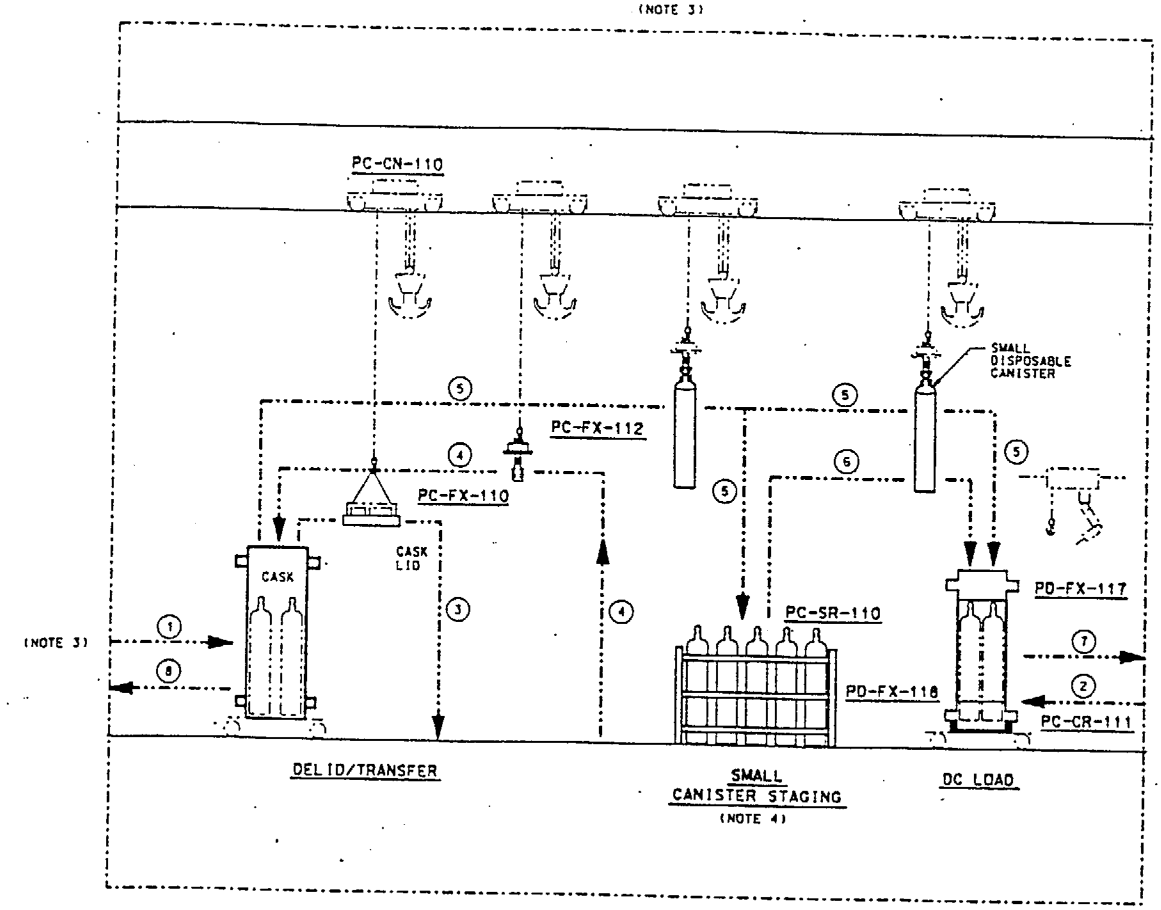


FIGURE 29

DESIGN INPUTS
SEE DRAWING INPUTS LIST

APPROVALS	INITIAL/DATE
DRAWN T SAUER	TS 5-29-97
ORIGINATOR K SCHWARTZTRAUBER	KGS 5-29-97
CHECKED R ZIMMERMAN	DRZ 5-29-97
VERIFICATION N/A	
LEAD DESIGN ENGINEER K SCHWARTZTRAUBER	KGS 5-29-97
QUALITY ASSURANCE N/A	
DEPARTMENT MANAGER S MEYERS	5-29-97

REV	DESCRIPTION	DATE							
00	ISSUE APPROVED	5-29-97	TS	KGS	DRZ	N/A	KGS	N/A	

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - CANISTER TRANSFER SYSTEM (SMALL CANISTER)

SIZE D | DOCUMENT IDENTIFIER: BCB000000-01717-2700-67010-00
SCALE NONE | QA CLASSIFICATION N/A | W.B.S. 1.2.4.6 | CAD FILE srm-sk011.dgn

PD-CN-104 EDC PREP BRIDGE CRANE 50 TON

PD-FX-117 DC LIFTING COLLAR

PD-FX-118 DC BASE COLLAR

PD-FX-112 EDC PREP OUTER LID LIFTING FIXTURE

PD-FX-110 EDC LIFTING YOKE

PD-FX-111 EDC INNER LID LIFTING FIXTURE

PD-CR-101 EDC TRANSFER CART

PD-DD-107 EDC PREP AREA ISOLATION DOOR

PD-FX-120 EDC PREP LIFTING BEAM

PU-FX-119 DC INNER LID SEALING ASSEMBLY

PD-DD-108 EDC/DC CELL SHIELD DOOR

NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. ROAD GRIME IS REMOVED FROM THE EMPTY DC AND CARRIER BEFORE ENTERING THE WASTE HANDLING BUILDING BY A WATER WASHDOWN DEVICE.
3. AFTER EDC REMOVAL, THE EMPTY CARRIER IS AVAILABLE FOR SHIPMENT BACK TO THE DC MANUFACTURER.
4. EMPTY DC'S ARE STAGED IN THE PREPARATION AREA, AS REQUIRED, TO MEET DC HANDLING SYSTEM DEMANDS. THE DC IS PREPARED FOR LOADING BY INSTALLING FUEL ASSEMBLY SPACERS, THE INNER LID, INNER LID SEAL ASSEMBLY, AND THE OUTER LID.
5. THE EDC TRANSFER CART, DC LIFTING COLLAR AND DC BASE COLLAR ARE DECONTAMINATED, AS REQUIRED, IN THE AIRLOCK PRIOR TO ENTERING THE EMPTY DC PREPARATION AREA.
6. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

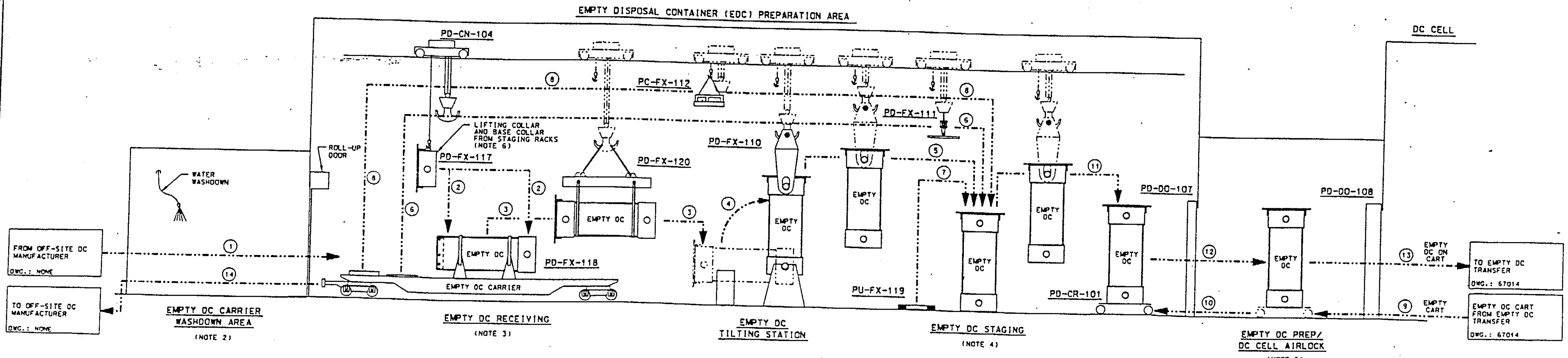


FIGURE 30

DESIGN INPUTS
SEE DRAWING INPUTS LIST

APPROVALS	INITIAL/DATE
DESIGN T SAUER	TS 5-29-97
ORIGINATOR K SCHWARTZTRAUBER	KS 5-29-97
CHECKER R ZIMMERMAN	RZ 5-29-97
CERTIFICATION N/A	
LEAD DESIGN ENGINEER K SCHWARTZTRAUBER	KS 5-29-97
QUALITY ASSURANCE N/A	
DEPARTMENT MANAGER S MEYERS	5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - EMPTY DC PREPARATION

SIZE D DOCUMENT IDENTIFIER: BCBD00000-01717-2700-67013-00
SCALE NONE | QA CLASSIFICATION N/A | W.B.S. 1.2.4.6 | CAD FILE srm-sk011.dgn

REV	DESCRIPTION	DATE							
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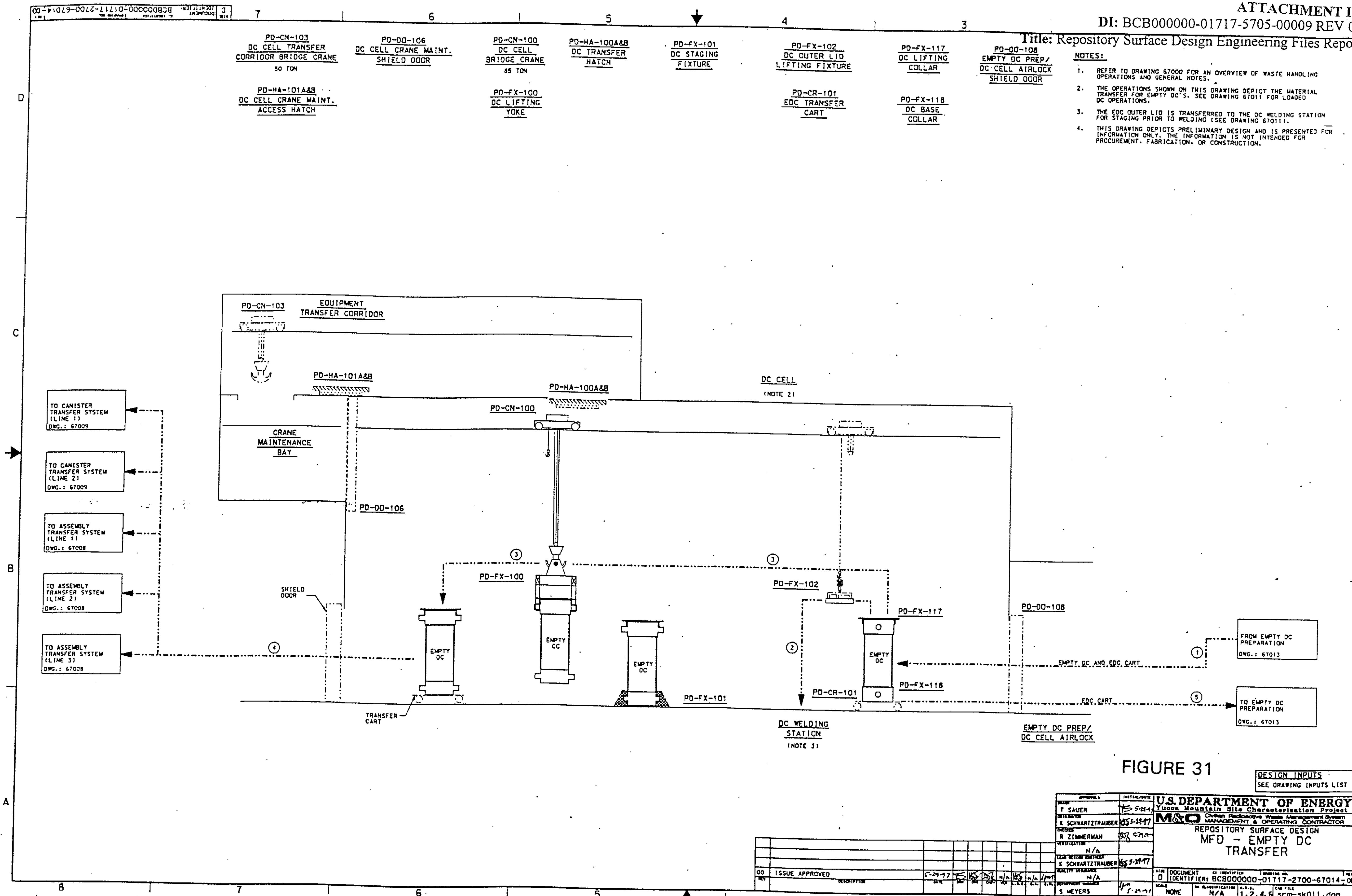

PD-CN-103
DC CELL TRANSFER CORRIDOR BRIDGE CRANE
50 TON
PD-HA-101A&B
DC CELL CRANE MAINT. ACCESS HATCH
PD-DO-106
DC CELL CRANE MAINT. SHIELD DOOR
PD-CN-100
DC CELL BRIDGE CRANE
85 TON
PD-FX-100
DC LIFTING YOKE
PD-HA-100A&B
DC TRANSFER HATCH
PD-FX-101
DC STAGING FIXTURE
PD-FX-102
DC OUTER LID LIFTING FIXTURE
PD-CR-101
EDC TRANSFER CART
PD-FX-117
DC LIFTING COLLAR
PD-FX-118
DC BASE COLLAR
PD-DO-108
EMPTY DC PREP/ DC CELL AIRLOCK SHIELD DOOR
NOTES:
1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. THE OPERATIONS SHOWN ON THIS DRAWING DEPICT THE MATERIAL TRANSFER FOR EMPTY DC'S. SEE DRAWING 67011 FOR LOADED DC OPERATIONS.
3. THE EDC OUTER LID IS TRANSFERRED TO THE DC WELDING STATION FOR STAGING PRIOR TO WELDING (SEE DRAWING 67011).
4. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.
EQUIPMENT TRANSFER CORRIDOR
CRANE MAINTENANCE BAY
DC CELL
(NOTE 2)
TO CANISTER TRANSFER SYSTEM (LINE 1) DWG.: 67009
TO CANISTER TRANSFER SYSTEM (LINE 2) DWG.: 67009
TO ASSEMBLY TRANSFER SYSTEM (LINE 1) DWG.: 67008
TO ASSEMBLY TRANSFER SYSTEM (LINE 2) DWG.: 67008
TO ASSEMBLY TRANSFER SYSTEM (LINE 3) DWG.: 67008
SHIELD DOOR
TRANSFER CART
EMPTY DC
FROM EMPTY DC PREPARATION DWG.: 67013
TO EMPTY DC PREPARATION DWG.: 67013
EMPTY DC AND EDC CART
EDC CART
DC WELDING STATION
(NOTE 3)
EMPTY DC PREP/ DC CELL AIRLOCK
DESIGN INPUTS
SEE DRAWING INPUTS LIST
U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
REPOSITORY SURFACE DESIGN
MFD - EMPTY DC TRANSFER
T SAUER
K SCHWARTZTRAUBER
R ZIMMERMAN
N/A
S MEYERS
00 ISSUE APPROVED 5-29-97
DOCUMENT IDENTIFIER: BCB000000-01717-2700-67014-00
NONE
1.2.4.6
srm-sk011.dgn

FIGURE 31

PD-CN-103 DC CELL TRANSFER CORRIDOR BRIDGE CRANE 50 TON

PD-CN-100 DC CELL BRIDGE CRANE 85 TON

PD-FX-100 DC LIFTING YOKE

PD-FX-101 DC STAGING FIXTURE

PD-HA-100A&B DC CELL TRANSFER HATCH

PU-FX-119 DC INNER LID SEALING ASSEMBLY

PD-ME-101A-H DC WELDING/ INSPECTION ROBOT

PD-FX-103 DC TILTING FIXTURE

PD-CR-100 WP HORIZONTAL TRANSFER CART

PD-HA-101A&B DC CELL CRANE MAINT. ACCESS HATCH

PD-DO-106 DC CELL CRANE MAINT. SHIELD DOOR

PD-FX-117 DC LIFTING COLLAR

PD-CN-102A-D DC WELDING STATION JIB CRANE 4 TON

PD-ME-102A-H DC WELDING STATION/TURNTABLE

PD-DO-100A-H DC WELDING STATION SHIELD DOOR

PD-EM-100 DC TILTING FIXTURE MANIPULATOR

PD-DO-101 DC CELL WP EXIT SHIELD DOOR

PD-FX-118 DC BASE COLLAR

PD-FX-102 DC OUTER LID LIFTING FIXTURE

PD-CN-101A-H DC WELDING STATION GANTRY CRANE 0.5 TON

PD-PY-100A-H DC INERTING MANIFOLD

NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF THE WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. DC STAGING FIXTURES ARE USED, AS NEEDED, TO TEMPORARILY STORE DC'S BEFORE OR AFTER DC WELDING.
3. DC WELDING STATION OPERATIONS INCLUDE THE FOLLOWING:
   A. ATTACH THE DC TO THE TURNTABLE.
   B. REMOVE THE INNER LID SEAL WITH JIB CRANE.
   C. WELD INNER LID AND CONDUCT NON-DESTRUCTIVE EXAMINATION (NDE).
   D. EVACUATE AND INERT WITH HELIUM.
   E. PLACE OUTER LID ON DC WITH JIB CRANE.
   F. WELD OUTER LID AND CONDUCT NDE.
4. OPERATIONS AT THE DC TILTING STATION INCLUDE THE FOLLOWING:
   A. TILT THE DC TO A HORIZONTAL POSITION WITH THE BRIDGE CRANE.
   B. EXTEND TOP OF TRANSFER CART TO LIFT THE DC.
   C. RELEASE AND REMOVE DC LIFTING COLLARS.
5. THE EDC OUTER LID IS TRANSFERRED FROM THE EDC TRANSFER CART AREA PRIOR TO DC WELDING (SEE DRAWING 67014).
6. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.

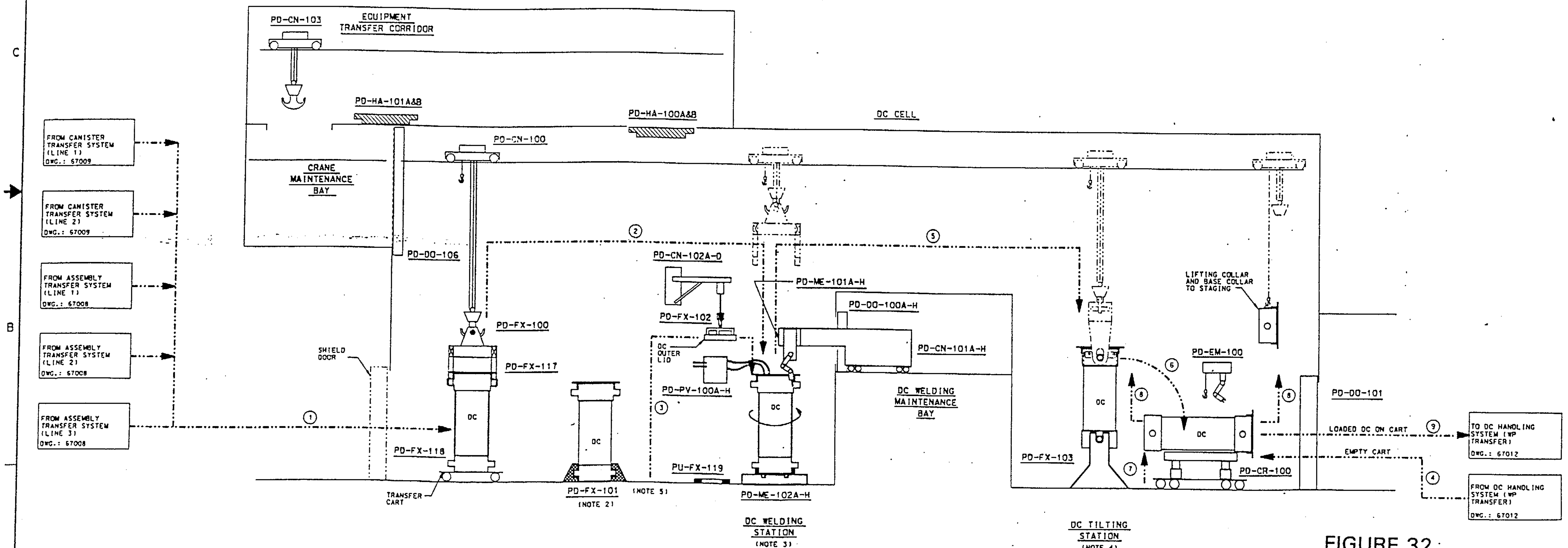


FIGURE 32

DESIGN INPUTS
SEE DRAWING INPUTS LIST

T SAUER	5-29-97
K SCHWARTZTRAUBER	5-29-97
R ZIMMERMAN	5-29-97
N/A	
K SCHWARTZTRAUBER	5-29-97
N/A	
S MEYERS	5-29-97

00 ISSUE APPROVED 5-29-97

U.S. DEPARTMENT OF ENERGY
Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

REPOSITORY SURFACE DESIGN
MFD - DC
HANDLING SYSTEM
(WELDING AND STAGING)

SIZE D DOCUMENT IDENTIFIER: BCBD00000-01717-2700-67011-00
SCALE NONE | QA CLASSIFICATION N/A | W.B.S. 1.2.4.6 | CAD FILE srm-sk011.dgn

PD-DO-101 DC CELL WP EXIT SHIELD DOOR

PD-FT-100 WP DECON SAMPLE PASS-THRU

PD-HI-100 WP HORIZONTAL LIFTING SYSTEM 80 TON

PD-DC-100A&B WP DECON DEVICE

PD-DO-103 WP AIRLOCK ISOLATION DOOR

PD-EM-101A&B WP DECON/ INSPECTION MANIPULATOR

PD-DO-102 WP LOAD SHIELD DOOR

NOTES:

1. REFER TO DRAWING 67000 FOR AN OVERVIEW OF WASTE HANDLING OPERATIONS AND GENERAL NOTES.
2. OPERATIONS AT THE WASTE PACKAGE TRANSFER/DECON AREA INCLUDE THE FOLLOWING:
   A. LIFT, AS REQUIRED, THE DC AND RETURN THE HORIZONTAL TRANSFER CART TO THE DC CELL.
   B. DECON THE DC, AS REQUIRED, AND SAMPLE TO CONFIRM ACCEPTABLE CONTAMINATION LEVELS.
   C. PLACE THE EMPLACEMENT RAILCAR UNDER THE DC.
   D. LOWER THE DC ONTO THE RAILCAR.
3. THIS DRAWING DEPICTS PRELIMINARY DESIGN AND IS PRESENTED FOR INFORMATION ONLY. THE INFORMATION IS NOT INTENDED FOR PROCUREMENT, FABRICATION, OR CONSTRUCTION.
4. THE WP TRANSFER CORRIDOR WILL INCLUDE A TURN-AROUND OR TURNTABLE RAIL SEGMENT TO ALLOW THE WP TRANSPORTER TO ENTER THE NORTH PORTAL IN THE ORIENTATION SHOWN OR A 180° ROTATED ORIENTATION.

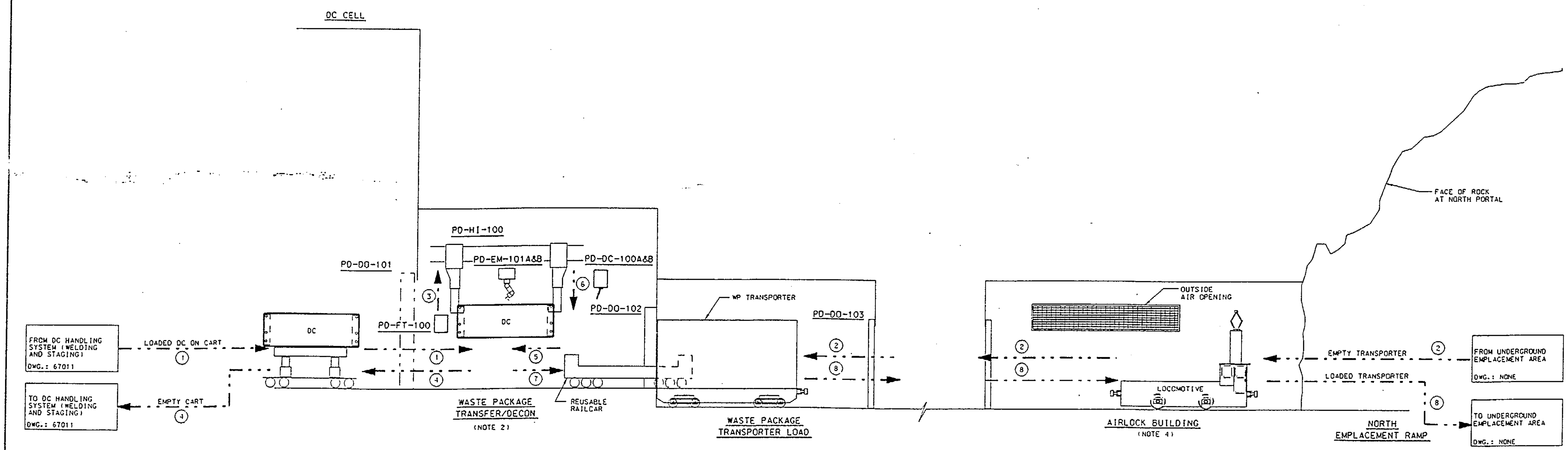
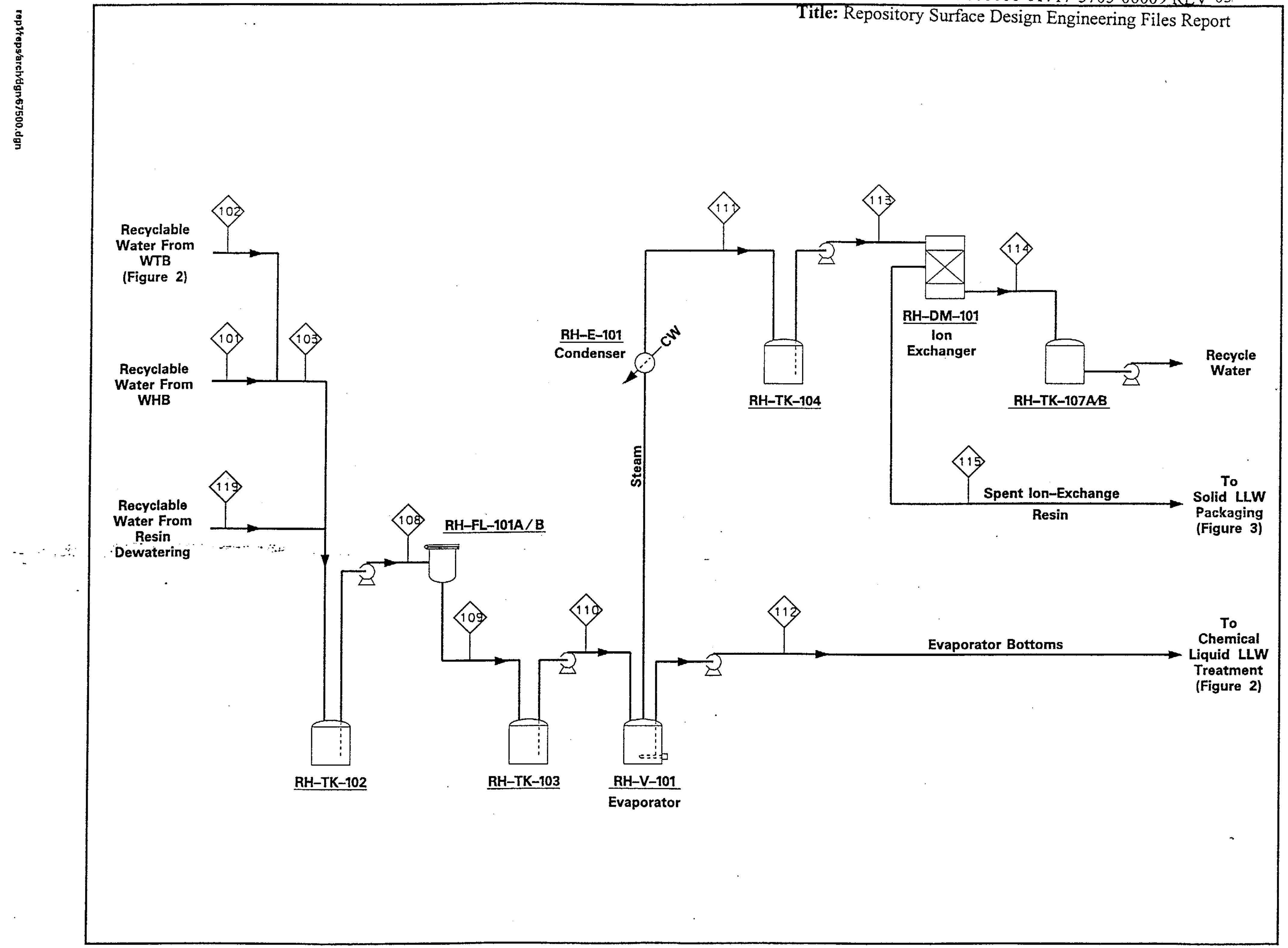


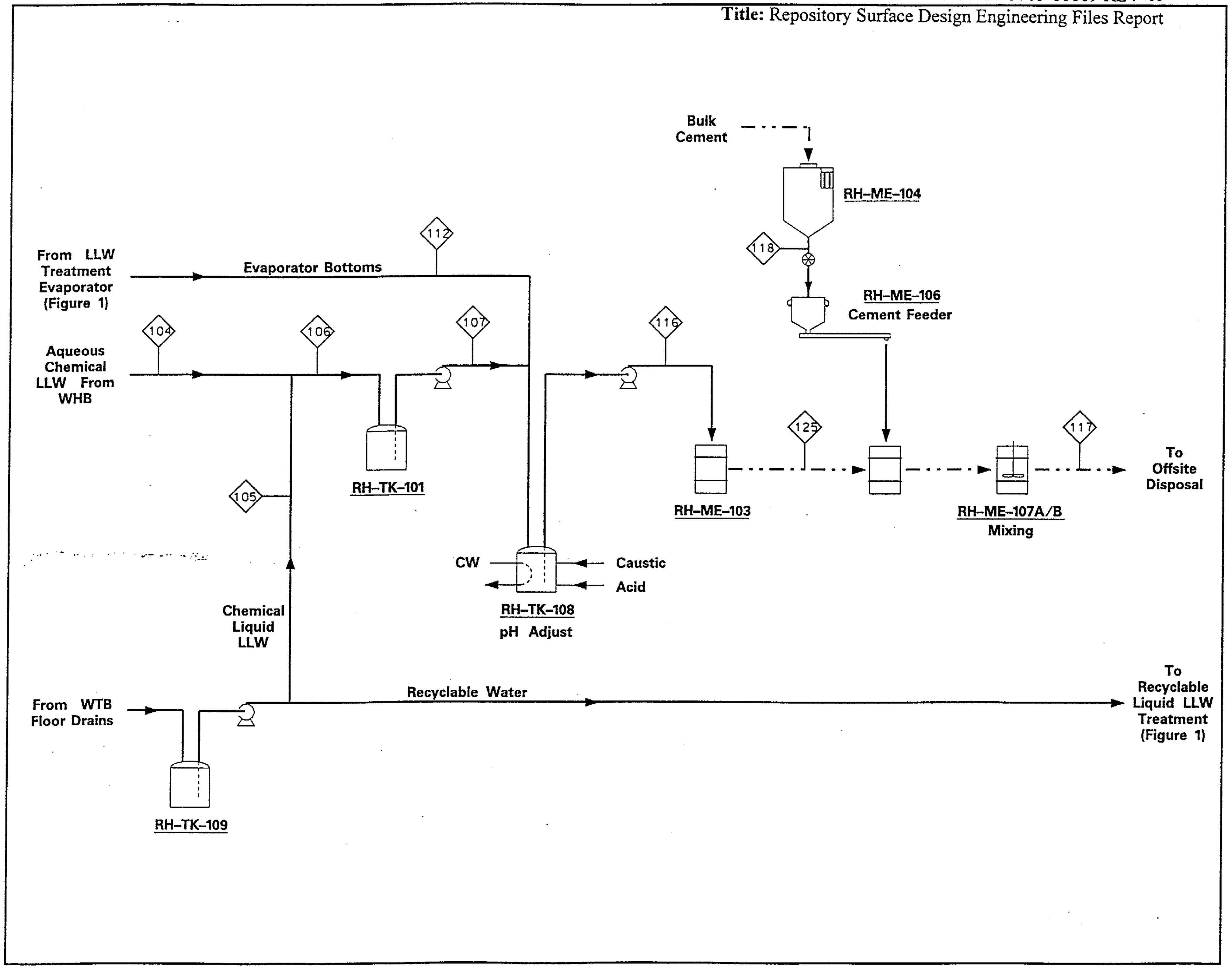
Figure 33
DC Handling System
(WP Transfer)

SAUERT t:\reps\arch\dgn\figure33.dgn 01-MAR-1999 10:21



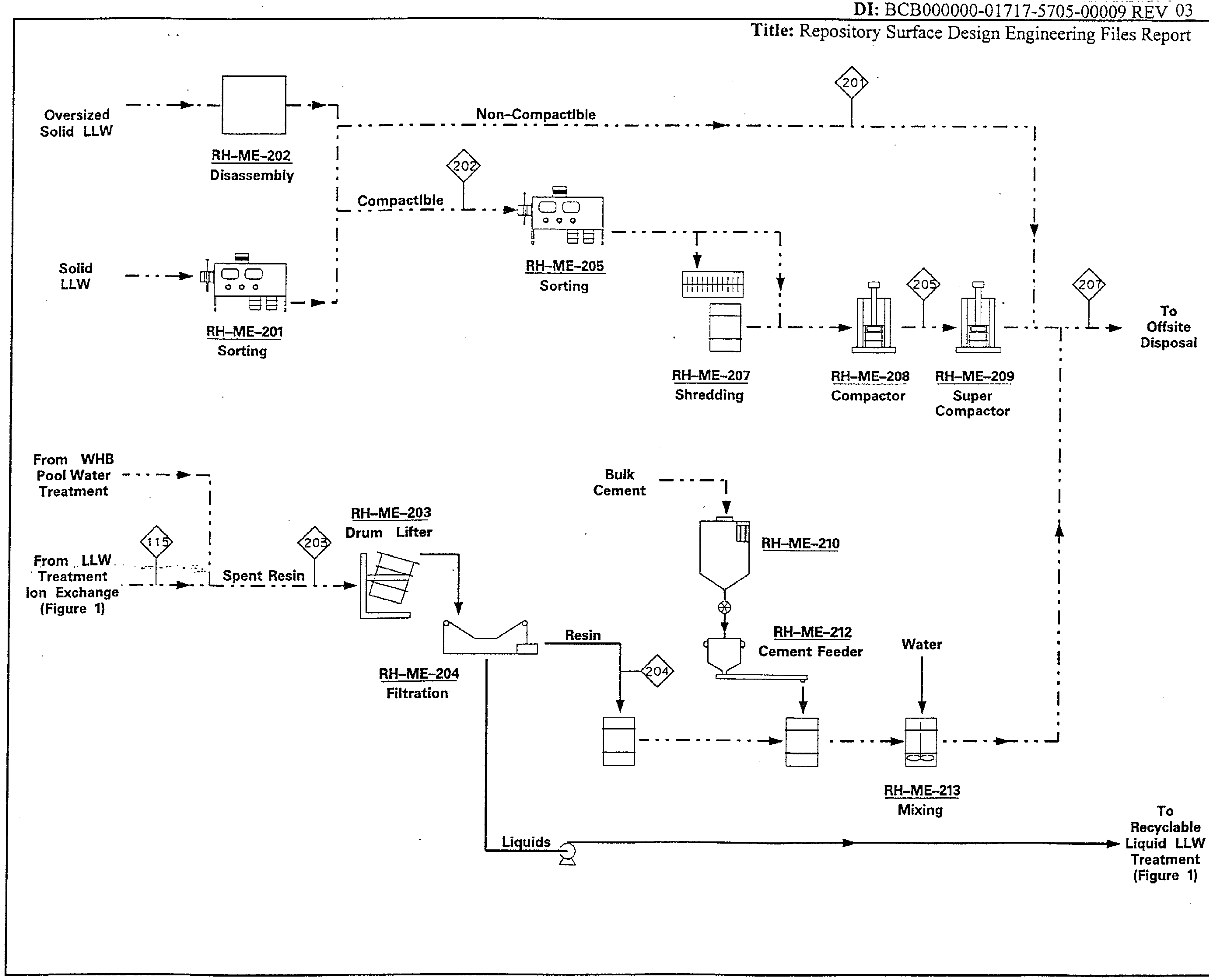
Recyclable Liquid LLW Treatment **FIGURE 34**

rep1/reps/arch/dgn/67500.dgn



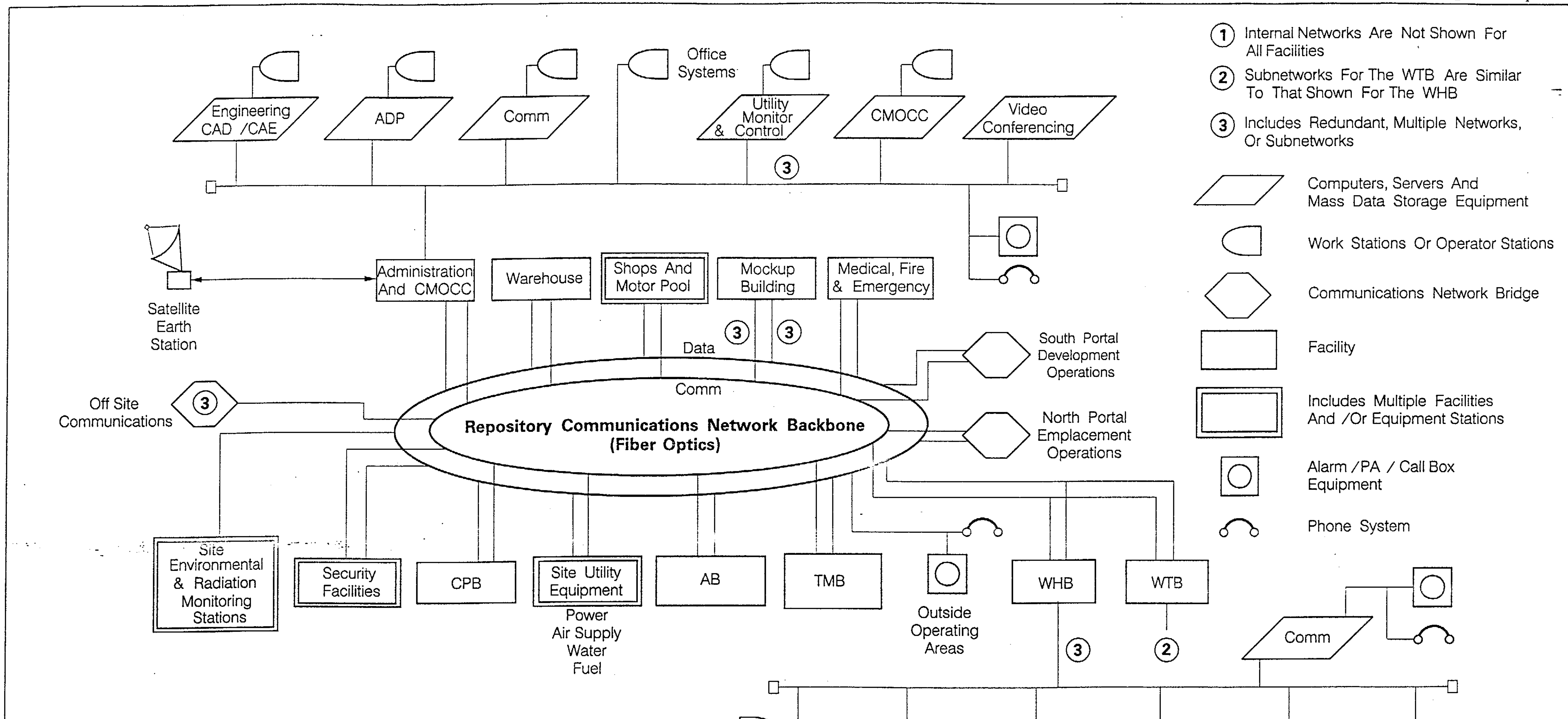
Chemical Liquid LLW Treatment

FIGURE 35



Solid LLW Packaging

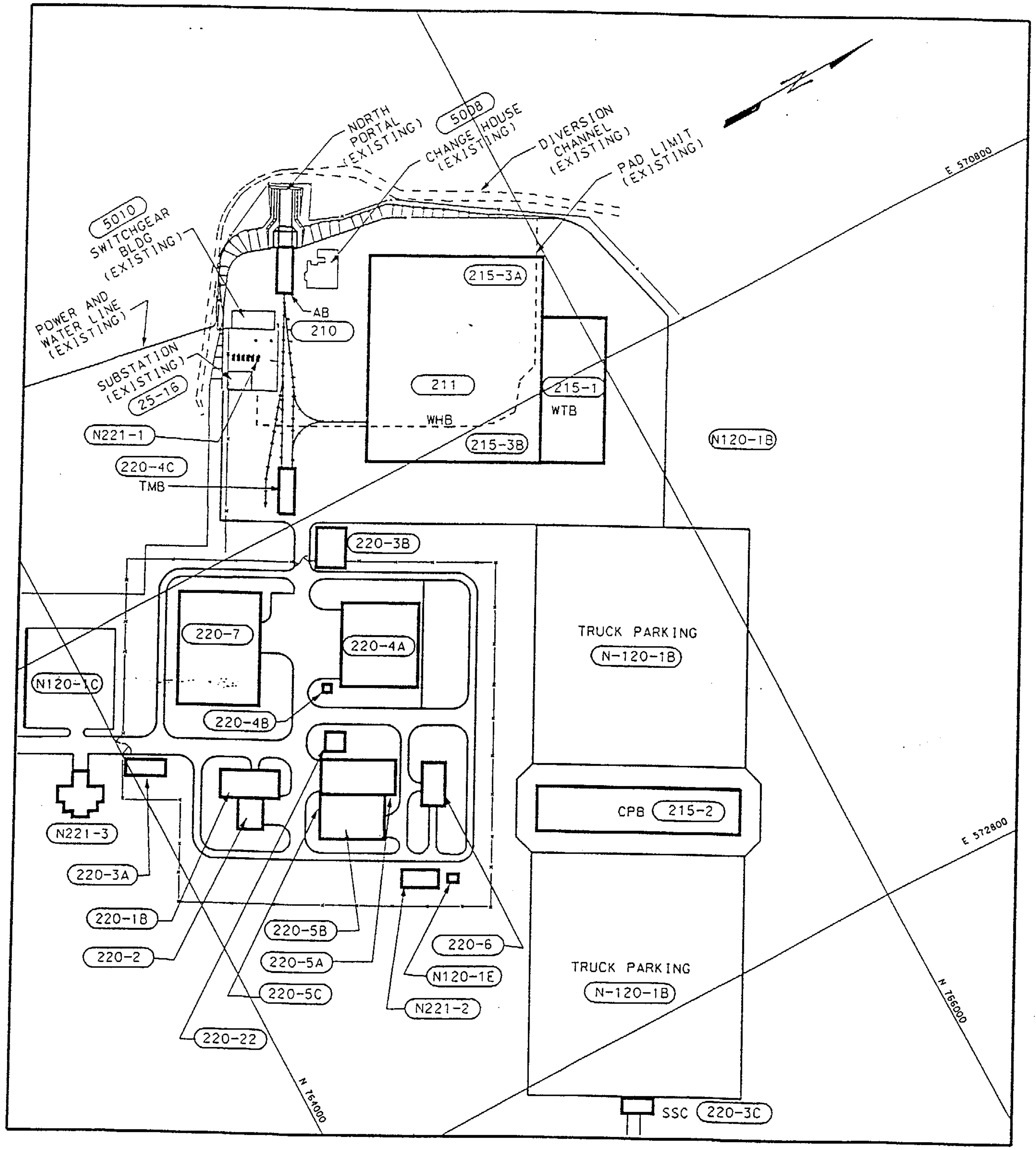
FIGURE 36



AB	Airlock Building
ADP	Automated Data Processing Equipment
WHB	Waste Handling Building
WTB	Waste Treatment Building
CMOCC	Central Management And Operations Control Center
CPB	Carrier Preparation Building
CAD	Computer Aided Design
CAE	Computer Aided Engineering
Comm	Communications
HP	Health Physics
RAD	Radiollogical Monitoring
FMCS	Facility Monitoring And Control
TMB	Transporter Maintenance Building

Site Communications System

FIGURE 37



RADIOLOGICALLY CONTROLLED AREA FACILITIES

210	AIRLOCK BLDG (AB)
211	WASTE HANDLING BUILDING (WHB)
215-1	WASTE TREATMENT BUILDING (WTB)
215-2	CARRIER PREPARATION BLDG (CPB)
215-3A	CARRIER WASHDOWN BLDG (CWB)
215-3B	CARRIER WASHDOWN BLDG (CWB)
220-4C	TRANSPORTER MAINTENANCE BUILDING (TMB)
N120-1A	RAIL PARKING
N120-1B	TRUCK PARKING
N221-1	STANDBY GENERATORS
25-16	SUBSTATION (EXISTING)
5008	CHANGE HOUSE (EXISTING)
5010	SWITCHGEAR BUILDING (EXISTING)

BALANCE OF PLANT AREA FACILITIES

220-3A	SECURITY STATION 1 (MAIN BOP PORTAL)
220-3B	SECURITY STATION 2 (RCA/BOP PORTAL)
220-3C	SECURITY STATION 3 (RCA TRUCK/RAIL PORTAL)
220-5A	ADMINISTRATION BUILDING
220-5B	FOOD SERVICE FACILITY
220-5C	TRAINING AUDITORIUM
220-1B	MEDICAL CENTER
220-2	FIRE STATION
220-22	COMPUTER CENTER
220-7	CENTRAL WAREHOUSE
220-4A	CENTRAL SHOPS
220-4B	MOTOR POOL AND FACILITY SERVICE STATION
220-6	MOCKUP BUILDING
N120-1E	COOLING TOWER
N221-2	UTILITY BUILDING

SITE SERVICE FACILITIES

N120-1C	GENERAL PARKING
N221-3	VISITOR CENTER

GRAPHIC SCALE
0 100 200 400 600 FEET
1" = 200'

FIGURE 38

NORTH PORTAL REPOSITORY
S-1 ALL LWT